

NEW NORMAL CURRICULUM

Instructional Guide

Mathematics

Class: XII (Business)



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Mathematics
Class: XII (Business Mathematics)



Royal Education Council
Royal Government of Bhutan

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FOREWORD

COVID-19 has suddenly caused unforgiving disruptions in public education all over the world, and brought about threats of fragmentation due to disparities in accessibility and connectivity in many systems. In Bhutan too, continuity of education and learning has been severely affected as a result of nationwide school closures and due to restrictions and health protocols. The disruptions have led to challenges in many existing patterns and trends in education resulting in a massive shift away from learning and teaching in traditional settings with physical interactions to the maximum in terms of relevancy and efficiency. This has caused a major problem for children living in poverty worldwide, who often rely on the physical settings of their schools for educational materials, guidance, and, sometimes, the only decent meal of the day.

In the new normal education, human interaction and well-being is a priority. Technology, particularly digital technology that enables communication, collaboration and learning across distance, is a formidable tool – not a panacea but a source of innovation and expanded potentials. As we embrace this exceptional opportunity to transform the world, and as we reimagine the organization of our educational institutions and learning environments, we will need to think about where we want to go.

In the post COVID 19 era, we must prioritize the development of the whole person, not just academic knowledge. Inspiration for the change can be drawn from the 1996 Delors report, *Learning the treasure within*, in its specification of four pillars of learning as “learning to know”, “to do”, “to be”, and “to live together”. Therefore, curricula must be increasingly perceived as integrated and based on themes and problems that allow learners to learn to live in peace with our common humanity and our common planet. This has the potential in the development of a strong base of knowledge about one’s self and about the world and finding purpose and being better able to participate in social and political milieu.

The New Normal Curriculum is, not just a mere response to the pandemic, but also a culmination of the curriculum reform work for the last four years by the Royal Education Council. It is an attempt to transform education from the teaching of “what” to learning of “how” and “why” towards empowering learners with the transversal competencies and the 21st century skills, and preparing them to be lifelong learners. We are optimistic that this move orients our education process towards nurturing nationally rooted and globally competent citizens.

Wish all our learners and teachers a life enriching experiential teaching and learning.

(Kinga Dakpa)
DIRECTOR GENERAL

1. INTRODUCTION

The 21st Century Education framework stipulates the emphasis on the thematic based learning areas with a comprehensive support system. The theme-based approach broadens opportunities for experiential learning contextualized to the learner's physical, social, political, economic, spiritual and cultural setting. An approach, which mandates learning through active engagement of students. Roles of teachers are transformed from knowledge transmitter to facilitation, guide, evaluator, researcher and motivator.

The conventional education, which is predominantly knowledge based and examination centred teaching and learning has been the time old practices, and the stress of this model is on the learning of textual information perceived by educators important for the grade. On the other hand, with the advancement in ICT, the world is flooded with such information, which are widely read by all at their leisure. What students cannot acquire from the multiple sources are the skills, which are crucial in facilitating students to realise their potential to be socially responsible and productive individuals and contribute in the nation building processes: socio-economic and political development. In the contemporary world, the knowledge-based education compromises the development of psychomotor and affective domains of learning, which affects the holistic development of students.

Despite the devastating effect caused by COVID-19 pandemic, it presented scopes for creation, innovation, generally perceived more efficient and effective in work and social activities. The pandemic situation explicated that the old ways of working, teaching and learning, and lifestyle have limitations. Consequently, new normal ways of how we work and live, teach and learn are the contemporary traditions. In this context, an overhaul of how we think and do is an imperative, not a choice. The transformation of classroom instruction from teacher centred to learner centred teaching and learning, however calls for the following adjustment, or even the overhaul of a few practices.

- i) Reduction of learning content to facilitate deep learning as opposed to the width of the teaching through the active engagement of students.
- ii) Integration of ICT as tools and ends of learner's education. The use of multimedia and ICT software is commonly utilized in teaching and learning as innovation to introduce variation in stimuli and sustain learner's interest and zeal in learning.
- iii) Adoption of theme based learning content, which facilitates to broaden the horizon of learning beyond the four walls, and stimulates the transfer of learnt concepts to the learner's immediate environment. This arrangement makes students aware of the realities of the social, political, economic and cultural practices and ethos of the society. Being aware of the immediate environment of the scopes and challenges, students are sensitized of the opportunities and issues, which may need attention for a better future for the society.
- iv) Consideration to ground the curriculum design and instruction approaches the epistemological theories is imperative to facilitate deep learning as opposed to

factual learning. However, the selection and use of them is subject to the nature of the respective subject. For instance, constructivism is more apt for science, while connectivism is relevant for languages and ICT curricula.

- v) Active engagement of students is imperative of competency-based education and learning. Inevitably, summative assessment has limitations in gauging the progressive development of the learner. This is achieved objectively by the use of the continuous formative assessment (CFA). However, if summative assessment evidence is used to provide feedback to help students in learning, it can serve as one of the techniques of CFA.

The curriculum adapted and grounded on the above wisdom, the principle of competency based learning, inspired by being aware of reality of the immediate environment, and the belief system of the society may be arbitrarily termed as the New Normal Curriculum. Learning is facilitated through the “Instructional Guide” with students taking responsibilities of their learning; teachers facilitate and guide students in the due course of their active engagement and assess their performance for improvement in their learning.

2. PURPOSE OF THE INSTRUCTIONAL GUIDE

In the New Normal Curriculum, deep learning synonymous to “less is more” is facilitated with the use of Instructional Guide for each subject and specific class. The content of the instruction in the guide for respective subjects are aligned with the subject’s curriculum framework with partial reference to the existing textbooks. Therefore, it is purported to achieve the following objectives:

- i) Facilitate learning anywhere, any time with the learner being responsible for the learning.
- ii) Facilitate deep learning with awareness and sensitivity of the realities of the world around.
- iii) Strengthen competency based learning and experiential learning to foster sensitivity of realities of the life and environment.
- iv) Strengthen blended learning and flip classroom with multimedia, digital pedagogies and ICT devices and websites as the tools and learning content.
- v) Guide parents in facilitating learning of their children.
- vi) Inspire teachers to assume the roles of facilitation, guide, motivator and evaluator.
- vii) Helps in the prioritization of learning content with emphasis to create time and space for active engagement of learners.
- viii) Facilitate the use of CFA for learning through objective observation and guidance.

The effective and efficient use of this guide is subject to the nature of the subject and the target class. The section on “How to Use the Guide” included in each subject provides tips on the efficient use of the guide.

3. GUIDING PRINCIPLES IN THE DEVELOPMENT OF THE GUIDE

The priority of education is to deliver learning that is relevant to the life of learners, challenge learners, foster the art of lifelong learning, serve as a source of inspiration and equip them with transversal skills. These principles form the basis for provision of learning experiences and engagement of learners in the developmental process of the curriculum, delivery, ways of achieving, and the context of measuring learner’s performance.

a. Competency based

Understanding that the contemporary world is flooded with information, which serve as the sources of knowledge and ideas, the education for the acquisition of knowledge is irrelevant and redundant. Consequently, the priority of education is shifting to empowering learners with transversal skills and life skills as means to help learners realize and develop their potential.

Therefore, this guide is to ensure that the teaching and learning emphasises on the development of skills and foster positive attitude for learning, as opposed to knowledge acquisition, through active engagement of learners in diverse learning experiences.

b. Experiential learning

Learner’s learning experiences are contextualised to the immediate environment – social, political, economic and physical, which provide opportunities for the development of competencies of creativity, critical thinking and problem solving, collaboration, communication, citizenship and cultural skills.

This is made possible through active engagement in diverse learning contexts and experiences. Such approach, thus speculates that the stress is on the understanding of fundamental concepts, principles, laws and ideas. This indicates that the peripheral ideas, examples and textual information are learnt as extended information. The integration of blended learning and flip classroom modes and place based education approach of instruction offer greater flexibility and opportunities to generate new knowledge by themselves along with the development of associated skills.

c. Gross National Happiness (GNH)

The principles of GNH should be deeply embedded in the curriculum for the holistic development of the learner. This will prepare the learner to participate and contribute to the culture, society, and economy of the country more meaningfully. The wisdom drawn from this principle is vital in the creation of “living school culture” and upholds the principle of emotional intelligence to foster gender sensitivity, equity and equality to education.

In this context, it is imperative of the guide that the elements of GNH are integrated as the learning content and are practiced as the inclusive pedagogical process in the classroom or at home.

d. Inclusiveness

It should value and include the knowledge, perspectives, and backgrounds and experiences of each learner to realise his or her full potential. Education is intended for all children in Bhutan, and due respect and acceptance is accorded to cohorts of learners from diverse backgrounds, and with cognitive and physical individual differences. It will mean deploying and accepting different starting points, a different pace of learning and ensuring that students are challenged to achieve high standards in ways that complement what they already know, what they can already do, and how they learn best.

This guide upholds the ideology of inclusiveness and education for all through the integration of diverse learning experiences and approaches, and assessment of the progress of their learning.

e. Learner-centered and developmentally appropriate

This implies that curricular contents, teaching techniques and assessment methods for each grade or level of school education are selected in accordance with children’s developmental stages and needs of individual learners. Each child is different and the rate at which an individual child grows and reaches various developmental stages varies, although the patterns and sequences for growth and development are usually the same for all. They should be able to progress at a rate, which matches their needs and aptitudes.

The curriculum should be relevant to the learners’ lives both current and future. It will be responsive to the social and technological changes and meet the needs of the students. It will thus be a balance between what is imperative for all the students, and be flexible for learning at the learner’s pace and time.

f. Approaches

According to John Dewey and other educators, progressive education must prepare learners for active participation in education. The focus of education must be

creating critical thinkers and inquirers who are active learners. Most progressive education programs have the following qualities in common:

- Integration of entrepreneurship into education
- Strong emphasis on problem solving and critical thinking
- Learning by understanding as the goals of learning as opposed to rote knowledge
- Collaborative and cooperative learning strategies to develop social skills
- Education for social responsibility and democracy
- Personalized learning and living school culture based on differentiated instruction accounting for each individual's personal needs and goals
- Integration of community service and service learning projects into the curriculum
- Emphasis on varied learning resources and de-emphasis on textbooks
- Integration of digital technologies and pedagogies
- Appropriate assessment techniques and tools deployed in the CFA

4. CURRICULUM CONTENT

This is the main part of the instructional guide. It contains suggested approaches to teaching to guide students to achieve the desired competency(ies) through the identified topic(s).

a. Broad theme /Strand/Chapter/Topic

Under this heading, the topic/topics under one strand or under different strands that can be addressed together is/are listed. The topics are taken from the framework and not from the textbooks.

b. Competency(ies)

Under this heading, the main competency(ies) associated with the topic(s) listed under 4.1 above is/are listed.

c. Pedagogy

Under this heading, pedagogy to provide direction to deliver a lesson when the teaching and learning happens through face to face (contact) or through a virtual mode (non-contact) if classes cannot be conducted due to school closures is recommended. The recommended pedagogies are linked to competencies. These pedagogical approaches are only recommendations and teachers have the leeway to design their own plans.

The pedagogies should focus on hands-on, experiential learning through problem-based or project-based approaches. In mathematics, students should be provided opportunities to connect, communicate and represent mathematical ideas. They should be provided with divergent thinking opportunities and reflect on their learning.

In case of non-contact approach, pedagogies should be supported through the:

- i) Use of relevant learning platform – Google Classroom, Sherig LMS, WeChat, WhatsApp, Telegram
- ii) Use of ICT Tools to deliver lessons – video conferencing tools (Zoom and Google Meet, etc.), MS power point, screen recording software, etc.)
- iii) Use of ICT tools for assessment (Google Forms, Google Docs, Google Sheet, etc)
- iv) Use of ICT Tools for recording and reporting the performance (Grading in Google Classroom, Google Sheet, etc. reporting – all assessment records to be transferred to progress report for promotion or detention)

d. Assessment

Under this heading, performance tasks focusing on assessing competencies and not content are recommended. For classes PP – III, teachers can align with the Continuous Formative Assessment (CFA) guide book.

Achievement of learning shall be recorded based on bands of achievement for all students in all classes. The evidence from assessment is to identify individual learning needs, design, and deliver appropriate interventions to support students falling in the beginning and approaching category.

Reporting for classes PP – III shall be on a quarterly basis as per CFA guide book. For other classes, it shall be based on existing policy till there is a change in policy. Marks obtained for each strand and ultimately for each subject from the formative assessment can be converted using appropriate conversions for summative purposes.

$$CA\ Marks = \frac{\text{ }_h}{\text{ }_h} \times CA\ for\ the\ term$$

e. Resources

All resources required for the suggested activities and tasks above are listed under this topic for both contact as well as non-contact teaching.

5. STRAND AND TOPIC-WISE INSTRUCTIONAL GUIDE

Topic: 12B-A1 Matrices

A. Competency(ies)

- Demonstrate an understanding of the concept of transpose, adjoint and inverse of matrices
- Use matrices to solve simultaneous equations in two or three unknowns variables

Objectives

- Identify different types of matrices based on number of elements, their arrangement and order.
- Solve problems involving addition, subtraction and multiplication of matrices
- Discuss some applications of matrix multiplication
- Calculate inverse of a matrix
- Apply the concept of matrix to solve the system of equations in two and three variables
- Examine the consistency of a given system of equations

B. Pedagogy

Contact teaching and learning

- Conduct pre-assessment on the Matrix. let students complete the questions given in the worksheets <http://bit.do/worksheet-multiplication>, <http://bit.do/worksheet-addition> to assess themselves.
- Allow students to define the Matrix. Then, briefly describe the types of matrices including rectangular, row, column, square, diagonal, scalar, null matrix, unit matrix or identity matrix (refer page number Ch 3-6 to 7, BHSEC Mathematics Book II).
- Let students explore operations on matrices; addition, subtraction & multiplication of matrices to complete the problem solving. Assign questions on operation of matrix from the web link <http://bit.do/addition-matrix> , <http://bit.do/multiplication-matrix>, <http://bit.do/matrix-Multiply> and <http://bit.do/operation-matrix>.
- Display the video <http://bit.do/properties-matrix-addition> and <http://bit.do/properties-matrix-multiplication> on properties of addition and multiplication. And also allow students to refer to BHSEC Mathematics Book II, page no. Ch 3-10 to 32 to prepare their own notes. Assign question 2 & 7 from Exercise 3(b), BHSEC Mathematics Book II, page no. Ch 3-16 to check their understanding on properties of addition. Assign question no. 3, 4 & 5 from Exercise 3(b), BHSEC Mathematics to evaluate their understanding on properties of multiplication.
- Design a group activity on application of matrix multiplication. Instruct students to refer BHSEC Mathematics Book II, page no. Ch 3-32 to 37 and surf the internet for additional information. Then, ask students to present their work on matrix multiplication.

- Suggestion: Provide questions from Exercise 3(d), BHSEC Mathematics Book II, page no. Ch 3-36.
- Display a video given in the web link <http://bit.do/matrix-Transpose> that contains methods to transpose matrices of order 2 and 3. Ask students to define the transpose of a matrix after watching a video. Assign Example 43 from BHSEC Mathematics Book II, page no. Ch 3-38 to 39 to practice problem solving on the transpose of a matrix.
- Demonstrate how to find adjoint of matrix of order 2 (refer the web link <http://bit.do/adjoint-matrix-order-2> and <http://bit.do/Inverse-matrix-order-2>). Assign a task from the worksheet given in the web link <http://bit.do/Inverse-matrix-order-2-question>.
- Display a video <http://bit.do/adjoint-matrix-3> on how to find adjoint of matrix of order 3. Provide practice questions to students from the video <http://bit.do/adjoint-matrix-3-question>. Then, allow students to watch a video <http://bit.do/inverse-matrix-3> on how to find the inverse of a matrix of order 3. Provide practice questions from the web link <http://bit.do/inverse-matrix-3-question>.
- Demonstrate how to solve the system of linear equations using Martin's Rule. Assign Example 76, BHSEC Mathematics Book II, page no. Ch 3-36 to solve the system of equations using Martin's rule.
- Prepare a PowerPoint presentation to introduce the condition of consistency and in-consistency with examples. Assign questions from Exercise 3(i), BHSEC Mathematics Book II, page Ch 3-70 to 71.
 - Suggestion: Refer the flow chart from page no. Ch 3-63 and solve example 74, 78 and 81 to check unique solutions, no solutions and infinitely many solutions respectively from page no. Ch 3-64 to 69, BHSEC Mathematics Book II.

Non-Contact teaching and learning

- Conduct pre-assessment on concept of Matrix. Let students complete the questions given in the worksheets <http://bit.do/worksheet-multiplication>, <http://bit.do/worksheet-addition> to assess themselves.
- Allow students to refer page number Ch 3-6 to 7, BHSEC Mathematics Book II. Instruct them to briefly describe the types of matrices including rectangular, row, column, square, diagonal, scalar, null matrix, unit matrix or identity matrix with one example each.
- Let students explore operations on matrices; addition, subtraction & multiplication of matrices to complete the problem solving. Assign questions on operation of matrix from the web links <http://bit.do/addition-matrix> , <http://bit.do/multiplication-matrix>, <http://bit.do/matrix-Multiply> and <http://bit.do/operation-matrix>.

- Display the video in the web links, <http://bit.do/properties-matrix-addition> and <http://bit.do/properties-matrix-multiplication> on properties of addition and multiplication. And also allow students to refer to BHSEC Mathematics Book II, page no. Ch 3-10 to 32 to prepare their own notes. Assign question 2 & 7 from Exercise 3(b), BHSEC Mathematics Book II, page no. Ch 3-16 to check their understanding on properties of addition. Assign question no. 3, 4 & 5 from Exercise 3(b), BHSEC Mathematics Book II to evaluate their understanding on properties of multiplication.
- Ask students to refer BHSEC Mathematics Book I, page no. Ch 3-32 to 37 and explore on application of matrices. Instruct students to surf the internet for additional information. Now, assign questions from Exercise 3(d), BHSEC Mathematics Book II, page no. Ch 3-36.
- Display a video given in the web link <http://bit.do/matrix-Transpose> that contains methods to transpose matrices of order 2 and 3. Ask students to define the transpose of a matrix at the end of the video. Assign Example 43 from BHSEC Mathematics Book II, page no. Ch 3-38 to 39 to apply the concept of transpose of a matrix.
- Share the video web links <http://bit.do/adjoint-matrix-order-2> and <http://bit.do/Inverse-matrix-order-2> on how to find adjoint of matrix of order 2. Assign a task from the worksheet given in the web link <http://bit.do/Inverse-matrix-order-2-question>.
- Share a video web link <http://bit.do/adjoint-matrix-3> on how to find adjoint of matrix of order 3. Provide practice questions to students from the video link <http://bit.do/adjoint-matrix-3-question>. Next, instruct students to watch a video <http://bit.do/inverse-matrix-3> on how to find the inverse of a matrix of order 3. Provide practice questions from the web link <http://bit.do/inverse-matrix-3-question>,
- Ask students to explore how to solve the system of linear equations using Martin's Rule. Assign Example 76, BHSEC Mathematics Book II, page no. Ch 3-36 to solve the system of equations using Martin's rule.
- Prepare powerpoint presentation to introduce the condition of consistency and in-consistency with examples. Assign questions from Exercise 3 (i), BHSEC Mathematics Book II, page no. Ch 3-70 to 71.
 - Suggestion: Refer the flow chart from page no. Ch 3-63 and solve example 74, 78 and 81 to check unique solutions, no solutions and infinitely many solutions respectively from page no. Ch 3-64 to 69, BHSEC Mathematics Book II.

C. Assessment

Contact & Non-Contact

Performance Task 1

- To enhance their understanding on addition, subtraction and multiplication of matrices assign practice questions from the worksheets <http://bit.do/worksheet-multiplication>, <http://bit.do/worksheet-addition>, <http://bit.do/addition-matrix>, <http://bit.do/multiplication-matrix> and <http://bit.do/operation-matrix>.
- Assign question 2, 3, 4, 5 & 7 from Exercise 3(b), BHSEC Mathematics Book II, page no. Ch 3-16 to check their understanding on properties of addition.
- Design appropriate assessment tools and record the student learning based on the template in the annexure 12B-A1.

Performance Task 2

- Design a group activity on application of matrix multiplication in our daily life. Assess students' work through presentation.
- To check every student's understanding on application of matrix multiplication, assign questions from Exercise 3(d), BHSEC Mathematics Book II, page no. Ch 3-36 to 37.
- Design appropriate assessment tools and record the student learning based on the template in the annexure 12B- A1

Performance Task

- To check their understanding on transpose, adjoint and inverse of a matrix allocate questions from Exercise 3(h), BHSEC Mathematics Book II, page no. Ch 3-59 to 61.
- Design appropriate assessment tools and record the student learning based on the template in the annexure 12B-A1.

Performance Task 3

- The consistency, inconsistency and Martin's rule can be assessed by providing questions from Exercise 3(i), BHSEC Mathematics Book II, page no. Ch 3-70 to 71.
- Assign Example 76, BHSEC Mathematics Book II, page no. Ch 3-36 to solve the system of equations using Martin's rule.
- Design appropriate assessment tools and record the student learning based on the template in the annexure 12B-A1.

D. Resources

Contact & Non-Contact

- a) Textbook (BHSEC Mathematics Book II)
- b) Online resources:
 - <https://www.youtube.com/watch?v=B4zejSl8zho>

- <http://bit.do/worksheet-multiplication>
- <http://bit.do/worksheet-addition>
- <http://bit.do/addition-matrix>
- <http://bit.do/multiplication-matrix>
- <http://bit.do/matrix-Multiply>
- <http://bit.do/operation-matrix>
- <http://bit.do/properties-matrix-addition>
- <http://bit.do/properties-matrix-multiplication>
- <http://bit.do/matrix-Transpose>
- <http://bit.do/adjoint-matrix-order-2>
- <http://bit.do/Inverse-matrix-order->
- <http://bit.do/Inverse-matrix-order-2-questio>
- <http://bit.do/adjoint-matrix->
- <http://bit.do/adjoint-matrix-3-questio>
- <http://bit.do/inverse-matrix-3>
- <http://bit.do/inverse-matrix-3-question>

c) Technological gadgets for learning (smart phone, desktop, laptop...)

E. Annexure(s)

Template to record assessment

Strand(s): Numbers and Operations		Topic(s): Matrices		
Competency: Demonstrate an understanding of the concept of transpose, adjoint and inverse of matrices				
Name of the student	Level of achievement			
	Beginning	Approaching	Meeting	Exceeding

A. Competency(ies)

- Solve problems on annuity and relate it to real life application (recurring deposit, loan, interest, etc.)

Objectives

- Define various terms related to annuity
- Solve problems on annuity and relate it to real life application (recurring deposit, loan, interest, etc.)

B. Pedagogy

Contact teaching and learning

- Define and differentiate the terms related to annuity (refer BHSEC Mathematics Book II, page Ch 19-3 to 4)
- May use the web link: <https://slideplayer.com/slide/3857884/> (slide 1 to 10) contains a PowerPoint presentation defining different terms and different types of annuities.
- Introduce 'Future value or Amount of an annuity' and explain the formulas to find future values of immediate annuity and annuity due (refer BHSEC Mathematics Book II, page Ch 19-4 to 5)
 - May also use the web link:
https://www.youtube.com/watch?v=5n_JBf-9ohA contains a video explaining the meaning of future value and how the formula for future value is generated.
- Demonstrate the use of formulas in practical questions (refer BHSEC Mathematics Book II, page Ch 19-4 to 9)
 - May use the web links:
<https://www.youtube.com/watch?v=izMPyNix0JM> contains a video explaining Future Value for immediate annuity with two examples.
<https://www.youtube.com/watch?v=joBu9TnFngQ&t=26s> contains video explaining Future value of annuity due with an example.
 - <https://www.youtube.com/watch?v=q-cfrQeiXGI> contains video showing an example on how to find the installment needed to be deposited to have a certain future value.
- Relate the 'future value of an annuity due' with the 'Recurring Deposits' in Banks of Bhutan.:
$$= -(1 + i)^n [(1 + i)^n - 1]$$
 - The future value or Amount(A) is called as the Maturity Amount in recurring deposits.
 - The amount of annuity, "a", is the installment.
 - The "i" is the interest (note: Banks in Bhutan compute interests monthly).

- Some banks use a simple interest formula to calculate the Maturity

$$\text{Amount: } = an + \frac{(i + 1)}{24}$$

- Eg: Ms. Pema wants to open a recurring account in one of the banks of Bhutan. She wishes to deposit Nu 1000 every month for two years. If the banks pay an interest rate of 7.25% p.a., find the maturity amount she would receive after two year.

- I. Using Simple Interest: $a = \text{Nu } 1000, i = 0.0725, n = 2 \times 12 = 24.$

Maturity Amount (A)=

$$1000(24) + \frac{1000(0.0725)(24)(25)}{24} = \text{Nu } 25812.5$$

- II. Using Compound Interest: $a = \text{Nu } 1000, i = \frac{0.0725}{12} = 0.00604, n = 24.$

Maturity Amount (A)=

$$\frac{1000}{0.00604} (1 + 0.00604)[(1 + 0.00604)^{24} - 1] = \text{Nu } 25,898.77$$

- Allow students to see the application of future value concepts in recurrent deposits in real context through Performance task 1.
- Allow students to work in groups to utilize the formulas in solving for different elements of an annuity; future value, installment or number of instalments of an annuity (refer BHSEC Mathematics Book II, page Ch 9 to 10, exercise 19(a); suggested questions - 4(i), 10, 12, 18)
- Introduce 'Present Value or Worth of an annuity' and explain the formulas of finding present values of immediate annuity, annuity due and perpetual annuity in comparison to those of future value (refer BHSEC Mathematics Book II, page Ch 19-11 to 13)
 - May use the web links:
 - <https://www.youtube.com/watch?v=wS2WPLHu9jY> contains a video explaining the relation between future value and present value and derives the formula for present value.
 - <http://bit.do/present-value-of-perpetuity> contains a [video](#) explaining the meaning of perpetual annuity and its formula to find present value of a perpetual annuity with an example.
- Demonstrate the use of formulas in practical questions (refer BHSEC Mathematics Book II, page Ch 19-13 to 19)
 - May use the web link: <https://www.youtube.com/watch?v=RU-osjAs6hE> contains a video explaining two examples of finding present value for immediate annuity using different methods.
 - May use the web line: <https://www.youtube.com/watch?v=Tr6SmLk4Qc4> contains a video explaining the present value of an annuity due with two examples.

- Relate the concept of “Present Value Immediate” with the loan systems in banks: $P = -[1 - (1 + i)^{-n}] \frac{a}{i}$
 - Based on the loan amount, the banks will calculate the monthly payments using the present value formula.
 - ‘P’ is the loan amount (the present value)
 - ‘a’ is the monthly payment. Banks call it as EMI - Estimated Monthly Instalment).
 - ‘i’ is the interest (Note: Banks in Bhutan compute interests monthly).
 - Allow students to see the application of present value concepts in calculating the EMI of loans. EMI formula can be derived from the Present Value formula:
 - $P = -[1 - (1 + i)^{-n}] \frac{a}{i}$
 - $EMI(i) = \frac{P \cdot i}{[1 - (1 + i)^{-n}]}$
 - Find the EMI of a loan using relevant examples.
- Allow students to work in groups to utilize the formulas in solving different types of questions under present value: (refer BHSEC Mathematics Book II, page Ch 9 to 10, exercise 19(b); suggested questions - 2(i), 6, 9, 11, 12(a), 15, 20,

Non-contact teaching and learning

- Conduct a zoom class explaining the definitions and different terms related to annuity using the PowerPoint presentation in the web link below. Instruct students to make notes.

<https://slideplayer.com/slide/3857884/> (slide 1 to 10) contains a PowerPoint presentation defining different terms and different types of annuities.
- Record and share short explanatory videos on any online learning media, explaining ‘Future value or Amount of an annuity’ and the formulas to find future values of immediate annuity and annuity due. (refer BHSEC Mathematics Book II, page Ch 19-4 to 5). Instruct students to make notes.
 - May also share the web link:

https://www.youtube.com/watch?v=5n_JBf-9ohA contains a video explaining the meaning of future value and how the formula for future value is generated.
- Post the web links which have tutorials demonstrating the use of formulas in practical questions.

<https://www.youtube.com/watch?v=izMPyNixojM> contains a video explaining Future Value for immediate annuity with two examples.

<https://www.youtube.com/watch?v=joBu9TnFngQ&t=26s> contains video explaining Future value of annuity due with an example.

<https://www.youtube.com/watch?v=q-cfrQEiXGI> contains [video showing](#) an example on how to find the installment needed to be deposited to have a certain future value.

- Create a PowerPoint presentation and explain the relation of the ‘future value of an annuity due’ with the ‘Recurring Deposits’ in Banks of Bhutan.:

$$= - (1 + i) [(1 + i)^n - 1]$$

- The future value or Amount(A) is called as the Maturity Amount in recurring deposits.
- The amount of annuity, “a”, is the installment.
- The “i” is the interest (note: Banks in Bhutan compute interests monthly).
- Some banks use a simple interest formula to calculate the Maturity

$$\text{Amount: } = an + \frac{(i + 1)}{24}$$

- Eg: Ms. Pema wants to open a recurring account in one of the banks of Bhutan. She wishes to deposit Nu 1000 every month for two years. If the banks pay an interest rate of 7.25% p.a., find the maturity amount she would receive after two year.

- Using Simple Interest: a = Nu 1000, i = 0.0725, n= 2×12=24.

$$\text{Maturity Amount (A)} = 1000(24) + \frac{1000(0.0725)(24)(25)}{24} = \text{Nu } 25812.5$$

- Using Compound Interest: a= Nu 1000, $i = \frac{0.0725}{12} = 0.00604$, n=24.

$$\text{Maturity Amount (A)} =$$

$$\frac{1000}{0.00604} (1 + 0.00604) [(1 + 0.00604)^{24} - 1] = \text{Nu } 25,898.77$$

- Allow students to see the application of future value concepts in recurrent deposits in real context through Performance task 1.
- Assign students homework questions where they will utilize the formulas in solving for different elements of an annuity; future value, installment or number of instalments of an annuity (refer BHSEC Mathematics Book II, page Ch 9 to 10, exercise 19(a); suggested questions - 4(i), 10, 12, 18)
- Provide notes (refer BHSEC Mathematics Book II, page Ch 19-11 to 13) and share the web link below on any online learning media to explain ‘Present Value or Worth of an annuity’ and the formulas to find present values of immediate annuity and annuity due. Ask students to make notes.

<https://www.youtube.com/watch?v=wS2WPLHu9jY> contains a video explaining the relation between future value and present value and derives the formula for present value.

<http://bit.do/present-value-of-perpetuity> contains a video [explaining](#) the meaning of perpetual annuity and its formula to find present value of a perpetual annuity with an example.

- Share the following web links which teaches how to find present values in practical questions (refer BHSEC Mathematics Book II, page Ch 19-13 to 19)

<https://www.youtube.com/watch?v=RU-osjAs6hE> contains a video explaining two examples of finding present value for immediate annuity using different methods.

<https://www.youtube.com/watch?v=Tr6SmLk4Qc4> contains a video explaining the present value of an annuity due with two examples.

- Record and post a video explaining the relation between the concept of “Present Value Immediate” with the loan systems in banks:

$$= -[1 - (1 +)^{-}]$$

- Based on the loan amount, the banks will calculate the monthly payments using the present value formula.
- ‘P’ is the loan amount (the present value)
- ‘a’ is the monthly payment. Banks call it as EMI - Estimated Monthly Instalment).
- ‘i’ is the interest (Note: Banks in Bhutan compute interests monthly).
- Allow students to see the application of present value concepts in calculating the EMI of loans. EMI formula can be derived from the Present Value formula:

$$\blacksquare = -[1 - (1 +)^{-}]$$

$$\blacksquare EMI() = \frac{\quad}{[1-(1+)^{-}]}$$

- Find the EMI of a loan using relevant examples.
- Assign students homework questions where they will utilize the formulas in solving different types of questions under present value: (refer BHSEC Mathematics Book II, page Ch 9 to 10, exercise 19(b); suggested questions - 2(i), 6, 9, 11, 12(a), 15, 20,

C. Assessment

Contact/ Non-contact

Performance task 1 (competency: Solve problems on annuity and relate it to real life application (recurring deposit, loan, interest, etc.)

Instruction: Assume that you want to open an RD account, depositing Nu 10,000 per month for 3 years. Explore and use the following web links which are online RD calculators of different banks, to calculate how much amount will be accumulated by the end of 3 years.

- Compare the interest rates and the amount accumulated, of different banks and check using the Future Value formula whether the instalments are computed with compound interest or simple interest.
- Which Bank would you choose to open the RD account?
 - <https://www.paisabazaar.com/rd-recurring-deposit-calculator/>
 - <https://www.tbankltd.com/calculator>
 - <https://www.bnb.bt/calc/>

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

Performance task 2 (competency: Solve problems on annuity and relate it to real life application (recurring deposit, loan, interest, etc.)

Design a set of questions related to the present value and loans. After calculating each EMI of the loans, students can verify their answers using the online EMI calculator of different banks given in web links below:

- <https://www.bnb.bt/calc/>
- <https://www.tbankltd.com/calculator>
- <https://www.bob.bt/emi-calculator/>

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

To record the achievement level on the competency, take the average of the achievements in the two Performance tasks.

D. Resources

Contact/Non Contact

- a) BHSEC Mathematics Book II
- b) Technological gadgets for learning (mobile, desktop, laptop...)
- c) Online resources:
 - <https://slideplayer.com/slide/3857884/>
 - https://www.youtube.com/watch?v=5n_JBf-9ohA
 - <https://www.youtube.com/watch?v=izMPyNixoJM>
 - <https://www.youtube.com/watch?v=joBu9TnFngQ&t=26s>
 - <https://www.youtube.com/watch?v=q-cfrQEiXGI>
 - <https://www.youtube.com/watch?v=wS2WPLHu9jY>
 - <http://bit.do/present-value-of-perpetuity>
 - <https://www.youtube.com/watch?v=RU-osjAs6hE>
 - <https://www.paisabazaar.com/rd-recurring-deposit-calculator/>
 - <https://www.tbankltd.com/calculator>
 - <https://www.bnb.bt/calc/>
 - <https://www.bnb.bt/calc/>
 - <https://www.tbankltd.com/calculator>
 - <https://www.bob.bt/emi-calculator/>

E. Annexure(s)

Refer 12B-A1 for template to record achievements

Topic: 12B-A3 Discount

A. Competency(ies)

- Demonstrate understanding of discount and solve related problems

Objectives

- Demonstrate an understanding of discount
- Solve problems related to trade discount, present value, true discount, banker's discount and banker's gain.

B. Pedagogy

Contact teaching and learning

- Conduct pre assessment tasks on finding cost price , selling price, discount and marked price . Refer worksheet <http://bit.do/Worksheet-Discount> or Understanding Mathematics Textbook for class X.
- Using the link <http://bit.do/Meaning-True-discount-present-value-bankers-gain>.

allow students to explore the meaning of trade discount, present value, true discount, banker's discount , banker's gain.Prepare a powerpoint presentation or video lesson.

- Demonstrate on calculating trade discount, present value, true discount, banker's discount and banker's gain.Refer ISC Business Mathematics for Class XII or browse the links
 - <http://bit.do/Trade-Discount>
 - <http://bit.do/Present-Value>
 - <http://bit.do/True-Discount>
 - <http://bit.do/True-Discount-Definition>
 - <http://bit.do/Banker-Discount>

Non-contact teaching and learning

- Prepare an online pre assessment task on calculating cost price , selling price, discount and marked price.Use the worksheet <http://bit.do/Worksheet-Discount> or Understanding Mathematics Textbook for class X.
- Using the link <http://bit.do/Meaning-True-discount-present-value-bankers-gain>.

allow students to explore the meaning of trade discount, present value, true discount, banker's discount , banker's gain.Prepare a powerpoint presentation or video lesson.

- Prepare a video lesson on calculating trade discount, present value, true discount, banker's discount and banker's gain.Refer ISC Business Mathematics for Class XII. Share the following links to the students

- <http://bit.do/Trade-Discount>
- <http://bit.do/Present-Value>
- <http://bit.do/True-Discount>
- <http://bit.do/True-Discount-Definition>
- <http://bit.do/Banker-Discount>

C. Assessment

Contact/ Non-contact

Performance 1

Assign questions on calculating trade discount, present value, true discount, banker's discount and banker's gain. Refer ISC Business Mathematics for Class XII or browse the links.

- <http://bit.do/Practice-questions-Discount>
- <http://bit.do/Trade-discount-questions>

D. Resources

Contact/ Non-contact

- a) Refer ISC Business Mathematics for Class XII
- b) Online Resources:
 - <http://bit.do/Worksheet-Discount>
 - <http://bit.do/Trade-Discount>
 - <http://bit.do/Present-Value>
 - <http://bit.do/True-Discount>
 - <http://bit.do/True-Discount-Definition>
 - <http://bit.do/Banker-Discount>
 - <http://bit.do/Practice-questions-Discount>
 - <http://bit.do/Trade-discount-questions>

E. Annexure(s)

Refer 12B-A1 for template to record achievement

Topic: 12B-A4 Permutations and Combinations

A. Competency(ies)

- Use the concept of permutation and combination according to the given situation

Objectives

- Differentiate permutation and combination
- Solve the problems using $C(n, r)$ and $P(n, r)$
- Identify different forms of permutation
- Identify the types of combination
- Apply different formula for permutation and combination depending on the cases

B. Pedagogy

Contact teaching and learning

- Conduct pre-assessment on concept of factorial; definition of $n!$ and solve 1 to 2 examples: $5!$, $9!$, etc.
- Define and differentiate between permutations as arrangement and combinations as selection with examples from real context. (refer BHSEC Mathematics Book-II page ch1-3 to 1-7)
 - Assess students' understanding of definition of permutations and combinations by Performance task 1.
- Discuss an example (refer BHSEC Mathematics Book II, page ch1-4 to 5; suggest questions - Ex. 1) and arrive at the fundamental principle of counting together with the students.
 - Could use the web link for further explanation: <https://www.youtube.com/watch?v=0NAASclUm4k> contains the video explaining the fundamental principle of counting.
 - May solve example 6 (BHSEC Mathematics Book-II page ch1-7). Allow students to list the outcomes using a tree diagram and then the teacher can find the total number of outcomes using the fundamental principle of counting. Thus showing two methods of counting the number of outcomes of tossing 3 coins. .
- Explain the value of (n, r) and different methods to calculate permutation of n things taken r at a time.
 - May use the web link: <https://www.youtube.com/watch?v=viKDzeyeCHr0> contains video explanations of different methods to calculate permutation of n things taken r at a time.
 - Assess students' learning using Performance task 2.
- Explain each type of permutation: restricted permutation, permutations of alike things, permutation of repeated things and circular permutations with examples (refer BHSEC Mathematics Book II, page ch1-12 to 1-20)

- May use the web links:
 - https://www.youtube.com/watch?v=W4eeXU_T53o&t=2s contains a video explaining an example of formation of numbers when repetition is not allowed and when repetition is allowed.
 - <https://www.youtube.com/watch?v=tBQhcP9Zr2E> contains a video explaining an example of arrangement of people on chairs
 - <https://www.youtube.com/watch?v=L81vWvqGvJ8> contains a video explaining an example of forming anagram (permutation of alike things).
 - <http://bit.do/circular-permutation> contains a video explaining circular permutations with example.
- Assess the students' understanding using Performance task 3.
- Define combinations and identify types of combinations
 - Explain the value of (n, r) and the corollaries (refer BHSEC Mathematics Book II, page ch1-22 to 23):
 1. $(n, n) = 1,$
 2. $(n, r) = (n, n - r),$
 3. If $(n, r) = (n, s)$ then either
 $r = s$ or $r = n - s, \dots + =$
 4. $(n, r) + (n, r - 1) = (n + 1, r)$
 - Use the web link to explain different methods of calculating combinations:
 - <http://bit.do/combination-concepts>
 - Assess students' learning through Performance task 2.
- Explain different types of combinations with help of examples. (refer BHSEC Mathematics Book II, page ch1-26 to 28; *suggested questions* - Ex. 44, 45, 47, 48, 50, etc)
 - May use the example from the web links:
 - <http://bit.do/combination1-concepts> contains a video explaining an example of selection of a group of boys and girls.
 - Assess students' learning through Performance task 3.
- Discuss examples under 'permutations and combinations occurring simultaneously' (refer BHSEC Mathematics Book II, page ch1-27, examples 52 and 53)

Non-contact teaching and learning

- Could design and post a short pre-assessment quiz on the concept of factorials, to check the previous knowledge of students.
- Provide notes on definitions of permutation as arrangement and combination as selection (refer BHSEC Mathematics Book-II page ch1-3 to 7)
Allow students to explore further with the help of performance task 1.
- Share the web link: <https://www.youtube.com/watch?v=0NAASclUm4k> contains the video explaining the fundamental principle of counting. Ask students to watch and make notes.

- Record and post short, focused videos on solving problems related to the fundamental principle of counting; could use example questions (refer BHSEC Mathematics Book-II, page ch1-7). Allow students to make notes.
Suggestion: Example 6; List the outcomes using a tree diagram and also find the total number of outcomes using the fundamental principle of counting; to show the students two methods of counting the number of outcomes of tossing 3 coins.
- Write and share notes on definition of permutations and the value of (n, r) . Ask students to copy the notes.
- Share the web link: <https://www.youtube.com/watch?v=viKDzyeCHr0> contains video with explanations of different methods to calculate permutation of n things taken r at a time. Allow students to make notes and assign Performance task 2 to assess their understanding.
- Design and share powerpoint presentations explaining each type of permutation: restricted permutation, permutations of alike things, permutation of repeated things and circular permutations, with appropriate examples. (refer BHSEC Mathematics Book II, page ch1-12 to 20)
 - Share the web links below for students to understand examples further under each type:
 - https://www.youtube.com/watch?v=W4eeXU_T53o&t=2s contains a video explaining an example of formation of numbers when repetition is not allowed and when repetition is allowed.
 - <https://www.youtube.com/watch?v=tBQhcP9Zr2E> contains a [video](#) explaining an example of arrangement of people on chairs
 - <https://www.youtube.com/watch?v=L81vWvqGvJ8> contains a [video](#) explaining an example of forming anagram (permutation of alike things).
 - <http://bit.do/circular-permutation> contains a video explaining [circular](#) permutations with example.
 - Assess students learning using Performance task 3.
- To define combinations and identify types of combinations
 - Could share the web link: <https://www.slideshare.net/AnubhavRoy7/permutations-and-combination-sfor-class-11> (slide 11 - 14) and ask students to make notes on definition of combination, values of (n, r) and corollaries. Also may refer to BHSEC Mathematics Book II, page ch1-22 to 24.
Suggestion:
- To teach the methods of finding combinations, share the web link, <http://bit.do/combination-concepts> which contains a video explaining different methods to calculate combinations. Allow students to make note and assign Performance task 2 to assess their learning.
- Record and share short and focused video tutorials solving different example questions from each type of combination and questions where permutations

and combinations occur simultaneously. (refer BHSEC Mathematics Book II, page ch1-25 to 28)

- May also share the web link: <http://bit.do/combination1-concepts> contains video explaining examples on selection of groups of boys and girls.
- Assess students learning through Performance task 3.

C. Assessment

Contact or Non Contact

- Performance task 1 - (Objective: Demonstrate understanding of permutation as arrangement and combination as selection)
 - Homework: Ask the students to compare and contrast between permutations and combinations. Allow students to give examples where they may use the concept of permutations and combinations in their day to day life.

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

- Performance task 2 - (Objectives - Solve the problems using $P(n, r)$ and $C(n,r)$)
 - Create and conduct a short quiz, aligned to the objective of finding the value of $(,)$ and $(,)$ (refer BHSEC Mathematics Book II - Chapter 1).
Sample: <http://bit.do/worksheet-combination-and-permutation>
 - For non-contact, conduct the quiz online.

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

- Performance task 3 - (Objectives: Apply concepts of permutation and combination to solve problems based on different situations)
 - Presentation: Select questions under different types of permutation and combinations (refer BHSEC Mathematics Book II, page Ch 1-20 to 21 and Ch 1-28 to 30, exercise 1(c and e)). Distribute one question each to each group of students. Allow them to discuss and solve the questions and deliver their understanding through presentation.
 - The students must be able to tell if the problem is related to permutation or to combination and must explain why they classified the problem as permutation or combination and how they identified the problem into the underlying types.
 - The students should discuss at least two approaches of solving their problem (e.g. logically or using $P(n,r)/C(n,r)$ formula).
 - For non-contact assessment, instruct students to complete this task individually exploring online resources and submit photos of the completed work.

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

D. Resources

Contact/Non Contact

- a) BHSEC Mathematics Book II
- b) Technological gadgets for learning (smart phone, laptop, desktop...)
- c) Online resources
 - <https://www.youtube.com/watch?v=0NAASclUm4k>
 - <https://www.youtube.com/watch?v=viKDzycCHr0>
 - https://www.youtube.com/watch?v=W4eeXU_T53o&t=2s
 - <https://www.youtube.com/watch?v=tBQhcP9Zr2E>
 - <https://www.youtube.com/watch?v=L81vWvqGvJ8>
 - <http://bit.do/circular-permutation>
 - <http://bit.do/combination-concepts>
 - <http://bit.do/combination1-concepts>
 - <http://bit.do/worksheet-combination-and-permutation>

E. Annexure (S)

Use a template given in 12B-A1 to record student achievements under each competency.

Topic: 12B-B1 Differentiation

A. Competency(ies)

- Find the derivatives and higher order derivatives of algebraic functions.

Objectives

- Find the derivative of composite, implicit and parametric functions (algebraic)
- Differentiate a functions with respect to another functions (algebraic)

B. Pedagogy

Contact teaching and learning

- Derivative of algebraic functions:
 - Discuss the concepts of the following topics by selecting one or two examples: *Meaning and geometrical interpretation of derivatives, differentiation from first principle, derivative of simple algebraic, derivative of sums, differences, products and quotients of functions, application of derivatives: Equation of tangent and normal involving algebraic functions.* Suggestions: Could discuss the following web link
 - <http://bit.do/general-derivative> the video contains general concepts on the topic.
- Algebraic Differentiation:
 - At Least four or five relevant examples of algebraic differentiation will be selected from BHSEC Mathematics Book II page number Ch 5-3 to17 on the following topics: 1) *derivative of algebraic sum of two function*, 2) *differentiation of product of two functions* 3) *derivative of the quotient of two functions* 4) *function of a function or composite function* 5) *differentiating by using chain rule method* 6) *differentiation of absolute value function* and 7) *differentiating interchanging of the dependent and independent variables*. The selected examples will be discussed in the class.
Suggestions: May use the following link:
The video contains derivatives using difference quotient
<https://www.youtube.com/watch?v=x8j-4WYLM6Y>
The video contains derivatives using chain rule
<https://www.youtube.com/watch?v=4s7G7nkMYHM>
The video contains derivatives of constant
<https://www.youtube.com/watch?v=n66nYARUyzs>
The video contains derivative using quotient rule
<https://www.youtube.com/watch?v=7TXDubwGOSk>
The video contains derivative using product rule
<https://www.youtube.com/watch?v=QeOTfHLG13c>
 - Design an individual task by assigning them to solve the following questions from the sources BHSEC Mathematics Book II page number Ch 5-7 and Ch 5-14.

Exercise 5(a) question 2(v), question 3(a), & (g) and question 6.
Exercise 5(b) question 4, question 9, question 13, question 18 and question 20.

- Derivatives of Implicit Function.
 - Explore the links, watch the video lessons:
<http://bit.do/implicit-function>
<https://www.youtube.com/watch?v=Zo630jMysKk> (the link contains a video on the derivative of implicit function). After completing, discuss the general methods and approaches to solve the solutions and discuss specific questions like: *which one is the explicit function? Why are those functions called implicit functions? How to make implicit into explicit functions? etc...*
 - Select example questions like (eg. 17, 19, & 21) from BHSEC Mathematics Book II page number Ch 5-43 to 44 and divide students into groups and ask them to discuss the solution of the given examples. After finishing their group discussion, ask one of them to present their findings to the class. For particular, the one who is dealing with example 21, will be given to answer the question like *why special methods are employed in differentiating such functions? etc,,*
 - Assign Individual Work: Ask them to solve selected questions; *question 1, question 2, question 3, question 5, question 6, question 14, 19(ii) & (iii) and question 21. (Source BHSEC Mathematic Boo II Exercise 5(h) page number Ch 5-45 to 46)* and check their solution in the class.
- Derivative of Parametric functions
 - Design a powerpoint presentation on the concept with examples and present it to children. May use a web link to supplement for better understanding of the concept let children watch the video link shared: <https://www.youtube.com/watch?v=kf2dZWqLnqE> (the link contains derivatives of the parametric of functions).
 - At least select two questions related to the objectives from Exercise 5(i) from BHSEC Mathematics Book II page number Ch 5-48 and ask them to solve individually. If children are finding difficulty in solving, for a supplement, recommend them to refer to the examples (eg 25, and 26) from BHSEC Mathematics Book II page number Ch 5-47.
- Differentiation of a function with respect to another function:
 - Discuss the definition of *Differentiation of a function with respect to another function. (Source: refer BHSEC Mathematics Book II page number Ch 5-49).*
 - The weblink <https://www.youtube.com/watch?v=M8iMROLjf-I> contains a video lesson on the topic, discussing procedures and allowing students to investigate the methods and steps involved in differentiating function with respect to other functions. Assign individual tasks by selecting relevant

questions from Exercise 5(j) from BHSEC Mathematics Book II page number Ch 5-50 to 51.

- Higher derivative (successive differentiation)
 - The weblink <https://www.youtube.com/watch?v=tBtF3Lr-VLk> contains the video lesson on successive differentiation.
First show: students will be given to watch without any discussion
Second show: In the second watch, conduct blended teaching, pause wherever relevant and discuss the important point.
 - At least select two questions from Exercise 5(l) (refer BHSEC Mathematics Book II, page number Ch 5-62) and use the link <https://www.derivative-calculator.net/> to differentiate the function. The method and steps will be discussed and students will be asked to copy the solutions accordingly.
 - Divide the students into groups and discuss the question from the link given <http://bit.do/practice-questions>. May write questions on the board and discuss or project the question through powerpoint and discuss.

Non-contact teaching and learning

The whole approach of teaching will be conducted through online class:

- Derivative of different algebraic functions:
 - Prepare the notes on the following topics like: *Meaning and geometrical interpretation of derivatives, differentiation from first principle, derivative of simple algebraic, derivative of sums, differences, products and quotients of functions, application of derivatives: Equation of tangent and normal involving algebraic functions.* The notes will be uploaded and made available in Google class or encourage students to refer and revise above topics from their previous note book too.
 - Suggestions:
To build the concepts on learned topics instruct them to explore the web link attached. The web link contains a video lesson on the general understanding of derivative:
<http://bit.do/general-derivative>
<http://bit.do/derivative-concept>
- Algebraic Differentiation:
 - Task I: Students will be ask to select at least two or three examples from the following topics (refer BHSEC Mathematics Book II page number Ch 5-3 to 5-17):
 - 1) derivative of algebraic sum of two function
 - 2) differentiation of product of two functions
 - 3) derivative of the quotient of two functions
 - 4) function of a function or composite function
 - 5) differentiating by using chain rule method
 - 6) differentiation of absolute value function and

- 7) differentiating interchanging of the dependent and independent variables and asking them to practice those examples.
- Task II: The following links will be shared in relevant class social media platform:
 - Link contains video on derivative using difference quotient
<https://www.youtube.com/watch?v=x8j-4WYLM6Y>
 - The video contains derivatives using chain rule
<https://www.youtube.com/watch?v=4s7G7nkMYHM>
 - The video contains derivatives of constant
<https://www.youtube.com/watch?v=n66nYARUyzs>
 - The video contains derivative using quotient rule
<https://www.youtube.com/watch?v=7TXDubwGOSk>
 - The video contains derivative using product rule
<https://www.youtube.com/watch?v=QeOTfHLG13c>

They are reminded to watch the full length of the lesson and ask them to do self study.
 - Task III: The following questions will be uploaded in the google class Exercise 5(a) question 2(v), question 3(a), & (g) and question 6. Exercise 5(b) question 4, question 9, question 13, question 18 and question 20. ask them to explore and solve the questions assigned to them. (refer BHSEC Mathematics Book II page number Ch 5-7 and Ch 5-14). And ask them to explore the solution.
 - Derivatives of Implicit Function:
 - Instruct children to explore the given two links.
<http://bit.do/implicit-function>
<https://www.youtube.com/watch?v=Zo630jMysKk>
(the link contains a video on the derivative of implicit function).
After completing, discuss general methods and procedures for approaching the solutions and ask specific questions like: *which one is the explicit function? Why are those functions called implicit functions? How to make implicit and explicit functions?*
 - Select example questions (eg. 17, 19 & 21) from BHSEC Mathematics Book II page number Ch 5-43 to 44 and individually ask children to explore the solution of the given examples. After finishing their task, ask one of them to present their findings to the class. For particular, the one who is dealing with example 21, will be given to answer the question like *why special methods are employed in differentiating such functions?*
 - Individual Work: This is another individual task where students need to find the solution by themselves the following questions will be projected through powerpoint - *question 1, question 2, question 3, question 5, question 6, question 14, 19(ii) & (iii) and question 21. (Source BHSEC Mathematic Boo II Exercise 5(h) page number Ch 5-45 to 46)*

- Derivative of Parametric functions:
 - Make a powerpoint presentation on the concept with examples and present it to children or use weblink given to supplement understanding of the concept <https://www.youtube.com/watch?v=kf2dZWqLngE> (the link contains a derivative of parametric of functions).
 - At least select 2 questions from Exercise 5(i) from BHSEC Mathematics Book II page number Ch 5-48 and ask them to solve individually. If children are finding difficulty in solving, for a supplement, recommend them to refer to the powerpoint lesson projected to them. The powerpoint lessons containing solution examples from examples 25 and 26 will be made ready. (source: BHSEC Mathematics Book II page number Ch 5-47 to 48).
- Differentiation of a function with respect to another function:
 - Discuss the definition of *Differentiation of a function with respect to another function*. (Source: refer BHSEC Mathematics Book II page number Ch 5-49).
Supplement: Encourage students to explore the web link <https://www.youtube.com/watch?v=M8iMROLjf-I> which contains a video lesson especially the procedures and steps involved differentiating function with respect to other functions.
 - Assign individual tasks by selecting 3 questions from Exercise 5(j) from BHSEC Mathematics Book II page number Ch 5-50 to 51 discuss the solution.
- Higher derivative (successive differentiation):
 - The weblink <https://www.youtube.com/watch?v=tBtF3Lr-VLk> will be uploaded in the google class. Instruction will be made very clear to children like in the first show, students will be given to watch without any discussion and in the second show, say discussion will happen, pause wherever relevant and discuss the important points accordingly.
 - At least select two questions from Exercise 5(l) (refer BHSEC Mathematics Book II, page number Ch 5-62) and use the link <https://www.derivative-calculator.net/> to differentiate the function. The method and steps will be discussed and students will be asked to copy the solutions.
 - Divide the students into groups and discuss the question from the link given <http://bit.do/practice-questions>. May write questions on the board and discuss or project the question through powerpoint and discuss.

C. Assessment

Contact

Performance task 1:

A set of questions related to objectives will be selected by the teacher referring to BHSEC Mathematics Book II, page Ch 5-3 to 63, and ask them to explore and solve.

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

Performance task 2:

Design and conduct quiz-type questions related to the objectives. Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

Non-contact

Performance task 1:

A set of questions related to objectives will be selected by the teacher referring to BHSEC Mathematics Book II, page Ch 5-3 to 63, and ask them to explore and solve.

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

Performance task 2:

Design and conduct online quiz-type questions related to the objectives. Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

D. Resources

Contact/ Non-contact

- a) BHSEC Mathematics Book II
- b) Technological gadgets for learning (smart phone, laptop, desk top...
- c) Online resources
 - <http://bit.do/general-derivative>
 - <http://bit.do/derivative-concept>
 - <https://www.youtube.com/watch?v=x8j-4WYLM6Y>
 - <https://www.youtube.com/watch?v=4s7G7nkMYHM>
 - <https://www.youtube.com/watch?v=n66nYARUyzs>
 - <https://www.youtube.com/watch?v=7TXDubwGOSk>
 - <https://www.youtube.com/watch?v=QeOTfHLG13c>
 - <http://bit.do/implicit-function>
 - <https://www.youtube.com/watch?v=Zo630jMysKk>
 - <https://www.youtube.com/watch?v=kf2dZWqLmqE>
 - <https://www.youtube.com/watch?v=M8iMROLjf-l>
 - <https://www.youtube.com/watch?v=tBtF3Lr-VLk>
 - <https://www.derivative-calculator.net/>
 - <http://bit.do/practice-questions>.

E. Annexure(s)

Use a template given in 12B-A1 to record student achievements in each competency.

Topic: 12B-B1 Differentiation

A. Competency(ies)

- Calculate maxima and minima of algebraic functions using higher order derivatives.

Objectives

- Calculate second order derivatives of a function and use it to find maxima and minima.

B. Pedagogy

Contact teaching and learning

- Turning point(s) of a function and maxima and minima:
 - Demonstrate and discuss turning points/stationary points, maximum and minima of functions. (Refer BHSEC Mathematics Book II page number Ch 6-2 to 3).
- Conditions for maxima and minima:
 - Make a short video lesson on conditions for maxima and minima (Refer BHSEC Mathematics Book II Page number Ch 6-5). A video lesson will be projected in the class and discuss the following questions from the lesson: *At a maximum point, what happens to the function and in which direction does it move? What would be the value of the function when a function is at the maximum point? What is point inflexion?*
- Modification of the second condition:
 - The concept can be taught by making powerpoint presentations and allowing group discussion. One may access materials from the link <http://bit.do/condition-maximum-minima> (the link contains the second condition for maxima and minima)
- Point of inflexion:
 - Explore the links:
 - <http://bit.do/inflexion-point> (video contains an introduction of point of inflexion)
 - <http://bit.do/inflexion-point2> (video contains a point of inflexion graphically)
 - <https://courseware.cemc.uwaterloo.ca/11/assignments/168/0> (video lesson on point of inflexion).
 - Class Activity: Conduct class activity to check the point of inflexion by using the given link <http://bit.do/inflexion-pointc>
 - Provide a note on *Necessary Conditions of point of inflexion* from BHSEC Mathematics Book II page number Ch 6-5.
- General condition for turning points:
 - Demonstrate and discuss the general condition for turning points (refer BHSEC Mathematics Book II page number Ch 6-5).

- Watch the video lesson to explore examples:
<http://bit.do/inflexion-point-condition> (the video contains a checking point of inflexion). Design similar questions and ask them to solve in class.
- Application of maxima and minima to practical problems:
 - Discuss three methods involving how to solve problems related to minimizing and maximizing a function (refer *BHSEC Mathematics Book II Page number Ch 6-9*). Select two examples from *BHSEC Mathematics Book II page number Ch 6-9 to 10* and discuss the problem in the class. May use <http://bit.do/algebraic-application>, <http://bit.do/algebraic1-application>, <http://bit.do/algebraic2-application> (link contains an application of derivatives in algebraic problem) for supplement.
- Extended activity:
 - Exploring the link <http://bit.do/application-of-derivatives> instruct students to find more application of derivatives.

Non-contact teaching and learning

- Turning point(s) of a function and maxima and minima:
 - Conduct online class to demonstrate and discuss turning points/stationary points, maximum and minima of functions. (Refer *BHSEC Mathematics Book II page number Ch 6-2 to 3*).
- Conditions for maxima and minima:
 - Make a short video lesson on conditions for maxima and minima (Refer *BHSEC Mathematics Book II Page number Ch 6-5*). Discuss the following questions from the video lesson: *At a maximum point, what happens to the function and in which direction does it move? What would be the value of the function when a function is at maximum point? What is point inflexion?*
- Modification of the second condition:
 - The concept can be taught by making powerpoint presentations and allowing children to discuss through the online lesson. One can use the materials referring to the link <http://bit.do/condition-maximum-minima> (the link contains the second condition for maxima and minima)
- Point of inflexion:
 - Post the following video link in the Google Classroom:
<http://bit.do/inflexion-point> (video contains the introduction of point of inflexion)
<http://bit.do/inflexion-point2> (video contains the point of inflexion graphically) and ask them to write the notes.
 - An online class can be conducted to check the point of inflexion by using the given link <http://bit.do/inflexion-pointc>

- Provide a note in the Google classroom on *Necessary Conditions of point of inflexion* referring to BHSEC Mathematics Book II page number Ch 6-5 and ask them to copy the notes.
- General condition for turning points:
 - Conduct online class, demonstrate and discuss the general condition for turning points (*refer BHSEC Mathematics Book II page number Ch 6-5*).
 - Post the video link <http://bit.do/inflexion-point-condition> (*the video contains a checking point of inflexion*) in Google class and ask students to watch the video and remind them to copy the examples from the video lesson. Similar questions will be designed and ask students to solve.
- Application of maxima and minima to practical problem:
 - Discuss during online class, the three methods involving how to solve problems related to minimizing and maximizing a function (*refer BHSEC Mathematics Book II Page number Ch 6-9*). Select two examples from BHSEC Mathematics Book II page number Ch 6-9 to 10 and discuss the problem through online class. May use <http://bit.do/algebraic-application>, <http://bit.do/algebraic1-application>, <http://bit.do/algebraic2-application> (*link contains an application of derivatives in algebraic problem*) for supplement.
- Extended activity:
 - Exploring the link <http://bit.do/application-of-derivatives> instruct students to find more application of derivatives.

C. Assessment

Contact/Non-contact

Performance task 1:

Application type questions will be given from BHSEC Mathe

Following question will be assigned to solve;

Question 1(i), (iii), 3, 5, 6 and 10 from BHSEC Mathematics Book II, page Ch 6-8 to 9.

Question 1(a), Question 3, Question 5, and Question 7 from BHSEC Mathematics page Ch 6-22.

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

Performance task 2:

Conduct an online practice quiz question from the link

<http://bit.do/inflexion-point-quize> (the link contains practice question points of inflexion)

<http://bit.do/inflexion-point-critical> (the link contains practice questions from finding critical point)

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

D. Resources

Contact/ Non-contact

- a) BHSEC Mathematics Book II
- b) Technological gadgets for learning (smart phone, laptop, desk top...
- c) Online resources
 - <http://bit.do/condition-maximum-minima>
 - <http://bit.do/inflexion-point>
 - <http://bit.do/inflexion-point2>
 - <http://bit.do/inflexion-pointc>
 - <http://bit.do/inflexion-point-condition>
 - <http://bit.do/inflexion-point-quize>
 - <http://bit.do/inflexion-point-critical>
 - <http://bit.do/algebraic-application>
 - <http://bit.do/algebraic1-application>
 - <http://bit.do/algebraic2-application>
 - <http://bit.do/application-of-derivatives>

E. Annexure(s)

Use a template given in 12B-AI to record student achievements in each competency.

Topic: 12B-B2 Integration

A. Competency(ies)

- Solve problems related to indefinite integrals using substitution and partial fractions

Objectives

- Apply substitution and partial fractions methods to find integral of algebraic functions

B. Pedagogy

Contact teaching and learning

- Recapitulate on the concepts learnt previously under Integral Calculus: integration as the inverse of differentiation or anti-derivative; integrals of algebraic functions and functions such as $\frac{1}{x}$ and $\frac{1}{x^2}$ and; integration by substitution for simple algebraic functions. (refer BHSEC Mathematics Book I, Chapter 17 or BHSEC Mathematics Book II, page Ch 7-3 to 5).
 - May use the web links:
<https://www.youtube.com/watch?v=e1nxhJQyLYI> (till 11:35 minutes) is a video on basic integral rules for algebraic functions.
<https://www.youtube.com/watch?v=8B31SAk1nD8> (till 22:35 minutes) is a video on substitution method for simple algebraic functions.
- Advance further on Integration by method of substitution
 - Demonstrate the use method of substitution to evaluate the integral of algebraic functions with appropriate examples (refer BHSEC Mathematics Book II, page ch 7-18 to 26; suggested questions - Ex. 13(4), 13(14) and exercise 7(d) Q25) and allow students to discuss similar examples.
- Introduce Integration using partial fraction
 - Share the web link below to the student to recap and to make notes from the IT lab on the concept of Partial Fractions.
<https://www.slideshare.net/slister07/5-3-partial-fractions> contains a PowerPoint presentation on partial fraction decompositions.
 - Explain use of partial fractions in evaluating integral with the help of examples for different types of partial fractions - non-repeated linear factors, repeated linear factors and quadratic factors (not resolvable into linear factors). (refer BHSEC Mathematics Book II, page Ch 7-44 to 53)
 - Use the web link:
 - <https://www.youtube.com/watch?v=GIGJdvdrdhs&t=60s> contains video explaining an example of integration using partial fractions (non-repeated linear factor).
 - Provide a group task to evaluate integrals using partial fractions from each type for discussion and presentation to the class on roll call. (refer BHSEC

Mathematics Book II, page Ch 7-53 to 54, exercise 7(g); suggested questions - 2, 8, 12, 14)

Non-contact teaching and learning

- Share the following web links on any online learning media, to recapitulate on the concepts learnt previously under Integral Calculus: integration as the inverse of differentiation or anti-derivative; integrals of algebraic functions and functions such as $\frac{1}{x}$ and $\frac{1}{x^2}$ and; integration by substitution for simple algebraic functions.
 - May use the web links:
 - <https://www.youtube.com/watch?v=e1nxhJQyLYI> (till 11:35 minutes) is a video on basic integral rules for algebraic functions.
 - <https://www.youtube.com/watch?v=8B31SAk1nD8> (till 22:35 minutes) is a video on substitution method for simple algebraic functions
 - Instruct students to make short notes referring to the previous year notebooks or through online resources.
- Advance further on Integration by method of substitution
 - Write and share notes on 'method of substitution' to evaluate the integral of algebraic functions with solved examples on any online learning platform (refer BHSEC Mathematics Book II, page Ch 7-18 to 26).
 - Allow students to practice further with similar questions (refer BHSEC Mathematics Book II, page Ch 7-18 to 26; suggested questions - Ex. 13(4), 13(14) and exercise 7(d) Q25).
- Introduce Integration using partial fraction
 - Share the web link <https://www.slideshare.net/slister07/5-3-partial-fractions> which contains a powerpoint presentation on partial fraction decompositions. Ask students to make notes referring to the slide as well as their class 11 notebook and submit for correction.
 - Prepare and post short videos solving one example each for evaluating integral using partial fractions for each type - non-repeated linear factors, repeated linear factors and quadratic factors (not resolvable into linear factors) and ask students to make notes. (refer BHSEC Mathematics Book II, page Ch 7-44 to 53)
 - Could also share the web link (other similar tutorials):
 - <https://www.youtube.com/watch?v=GIJdvdrdhs&t=60s> contains video explaining an example of integration using partial fractions (non-repeated linear factor)
 - Provide an online task for students to evaluate integrals using partial fractions from each type and ask to present their work in the form of a video recording. (refer BHSEC Mathematics Book II, page Ch 7-53 to 54, exercise 7(g); suggested questions - 2, 8, 12, 14)

C. Assessment

Contact/ Non-contact

Performance task 1: (competency - Solve indefinite integrals using different methods)

Conduct test(s) aligned to different methods of evaluating integrals (may conduct a test every time after each method is taught) to assess and record the level of achievement under competency 1. (refer BHSEC Mathematics Book II, page Ch 7-3 to 53, exercises 7 (c, d and g))

Assess, provide feedback and record the achievement based on the template given in the annexure 12B-A1.

D. Resources

Contact/Non Contact

- a) BHSEC Mathematics Book II
- b) Technological gadgets for learning (smart phone, laptop, desk top...)
- c) Online resources:
 - <https://www.youtube.com/watch?v=e1nxhJQyLYI>
 - <https://www.youtube.com/watch?v=8B31SAk1nD8>
 - <https://www.slideshare.net/slister07/5-3-partial-fractions>
 - <https://www.youtube.com/watch?v=GIGJdvdrdhs&t=60s>

E. Annexure(s)

Refer 12B-A1 for template to record achievement

Topic: 12B-B3 Application of Calculus in Commerce and Economics

A. Competency(ies)

- Solve problems involving costs and revenues in commerce and economics using calculus

Objectives

- Define Total Cost, Variable Cost, Average Cost, Marginal Cost, Total Revenue, Marginal Revenue and Average Revenue;
- Find marginal cost and average cost when total cost is given
- Find marginal revenue and average revenue when total revenue is given
- Find optimum profit and minimum total cost under given conditions
- Find total cost/ total revenue when marginal cost/marginal revenue are given, under given conditions
- Minimization of Average cost or total cost and Maximization of total revenue, total profit. of set
- Determination of cost function and total revenue function

B. Pedagogy

Contact teaching and learning

- Introduce the lesson by explaining the significance of application of derivatives in commerce and economics.
- Define functions (cost function, demand function, revenue function, profit function and break-even point) and explain the equations along with an example of each function. *Suggestion: refer to the link: <http://bit.do/Applications-of-derivatives> to extract ideas for the concepts from the Article 41.1 (Basic Functions).*
 - Discuss the questions from BHSEC Mathematics Book II, Page Ch 20-6 (Ex.2, Ex.3 and Ex.4) to identify and to determine the functions.
- Define and explain Average and Marginal functions given in the Article 41.1.6 (Average and Marginal functions) and discuss the solved example 41.4 to 41.6, Page 216-218 refer the link: <http://bit.do/Applications-of-derivatives>.
- Explain Average Revenue and Marginal Revenue given in *the Article 41.2* (Average Revenue and Marginal Revenue) and discuss the solved example 41.7 to 41.9, Page 219-220 refer the link: <http://bit.do/Applications-of-derivatives>.
- Discuss about minimization of average cost or total cost and Maximization of total revenue and total profit with respect to level of outputs illustrated under the title: *Minimization of Average cost or total cost and Maximization of total revenue and total profit* Page 221 to 222 and discuss the solved example 41.10 to 41.15, Page 222 to 225 refer the link: <http://bit.do/Applications-of-derivatives>.
- Explain how the total cost function can be determined by integrating Marginal cost function. Refer Article 41.3.1 titled *Determination of cst function* Page

226. Discuss solved example 41.16 to 41.18, Page 228-229 to demonstrate it and refer the resource from this link: <http://bit.do/Applications-of-derivatives>.
- Explain how the total revenue function can be determined by integrating Marginal revenue function. Refer Article 41.3.2 titled *Determination of total revenue function* Page 228. Discuss solved example 41.19 to 41.20, Page 226-228 to demonstrate it and refer the resource from this link: <http://bit.do/Applications-of-derivatives>.

Non-contact teaching and learning

Share video lesson through a learning management system (google classroom) or social media prepared by inculcating the following:

- Introduce the lesson by explaining the significance of application of derivatives in commerce and economics.
- Define functions (cost function, demand function, revenue function, profit function and break-even point) and explain the equations along with an example of each function. *Suggestion: refer to the link: <http://bit.do/Applications-of-derivatives> to extract ideas for the concepts from the Article 41.1 (Basic Functions).*
 - Discuss the questions from BHSEC Mathematics Book II, Page Ch 20-6 (Ex.2, Ex.3 and Ex.4) to identify and to determine the functions.
- Define and explain Average and Marginal functions given in the Article 41.1.6 (Average and Marginal functions) and discuss the solved example 41.4 to 41.6, Page 216-218 refer the link: <http://bit.do/Applications-of-derivatives>.
- Explain Average Revenue and Marginal Revenue given in the Article 41.2 (Average Revenue and Marginal Revenue) and discuss the solved example 41.7 to 41.9, Page 219-220 refer the link: <http://bit.do/Applications-of-derivatives>.
- Discuss about minimization of average cost or total cost and Maximization of total revenue and total profit with respect to level of outputs illustrated under the title: *Minimization of Average cost or total cost and Maximization of total revenue and total profit* Page 221 to 222 and discuss the solved example 41.10 to 41.15, Page 222 to 225 refer the link: <http://bit.do/Applications-of-derivatives>.
- Explain how the total cost function can be determined by integrating Marginal cost function. Refer Article 41.3.1 titled *Determination of cst function* Page 226. Discuss solved example 41.16 to 41.18, Page 228-229 to demonstrate it and refer the resource from this link: <http://bit.do/Applications-of-derivatives>.
- Explain how the total revenue function can be determined by integrating Marginal revenue function. Refer Article 41.3.2 titled *Determination of total revenue function* Page 228. Discuss solved example 41.19 to 41.20, Page 226-228 to demonstrate it and refer the resource from this link: <http://bit.do/Applications-of-derivatives>.

Suggestion: You may use the given links: https://youtu.be/_EXQiR9Q4kY (Explains about functions and and break even analysis with the examples), <https://youtu.be/JEIH5HeneXc> (Defines about revenue function, cost function and profit function with solved problems), <https://youtu.be/q3jeT5p15Zo> (Discusses about marginal and break even analysis with the examples) and <http://bit.do/Applications-of-derivatives> (pdf. file Application of calculus in Commerce and Economics) to prepare the lesson video.

C. Assessment

Contact

Performance task 1

Ask students to solve the problems from Page 215 (Check Your Progress 41.1) Question 1 to 6 from the given link: <http://bit.do/Applications-of-derivatives..> Assess and provide feedback, and record achievement based on the template given in the annexure.

Performance task 2

Ask students to solve the problems from Page 220 -221 (Check Your Progress 41.2) Question 1 to 5 from the given link: <http://bit.do/Applications-of-derivatives.> Assess and provide feedback, and record achievement based on the template given in the annexure.

Performance task 3

Ask students to solve the problems from Page 221 (Check Your Progress 41.2) Question 6 to 8 from the given link: <http://bit.do/Applications-of-derivatives.> Assess and provide feedback, and record achievement based on the template given in the annexure.

Performance task 4

Ask students to solve the problems from Page 225 to226 (Check Your Progress 41.3) Question 1 to 6 and 8 from the given link: <http://bit.do/Applications-of-derivatives.> Assess and provide feedback, and record achievement based on the template given in the annexure.

Performance task 5

Ask students to solve the problems from Page 229 (Check Your Progress 41.4) Question 1 to 3 from the given link: <http://bit.do/Applications-of-derivatives.> Assess and provide feedback, and record achievement based on the template given in the annexure.

Performance task 6

Ask students to solve the problems from Page 229 (Check Your Progress 41.4) Question 4 from the given link: <http://bit.do/Applications-of-derivatives>. Assess and provide feedback, and record achievement based on the template given in the annexure.

Non-contact

Performance task 1

Ask students to solve the problems from Page 215 (Check Your Progress 41.1) Question 1 to 6 from the given link: <http://bit.do/Applications-of-derivatives> and to upload their work in google classroom to provide feedback and to assess. Assess and provide feedback, and record achievement based on the template given in the annexure.

Performance task 2

Ask students to solve the problems from Page 220 -221 (Check Your Progress 41.2) Question 1 to 5 from the given link: <http://bit.do/Applications-of-derivatives> and to upload their work in google classroom to provide feedback and to assess. Assess and provide feedback, and record achievement based on the template given in the annexure.

Performance task 3

Ask students to solve the problems from Page 221 (Check Your Progress 41.2) Question 6 to 8 from the given link: <http://bit.do/Applications-of-derivatives> and to upload their work in google classroom to provide feedback and to assess. Assess and provide feedback, and record achievement based on the template given in the annexure.

Performance task 4

Ask students to solve the problems from Page 225 to226 (Check Your Progress 41.3) Question 1 to 6 and 8 from the given link: <http://bit.do/Applications-of-derivatives> and to upload their work in google classroom to provide feedback and to assess. Assess and provide feedback, and record achievement based on the template given in the annexure.

Performance task 5

Ask students to solve the problems from Page 229 (Check Your Progress 41.4) Question 1 to 3 from the given link: <http://bit.do/Applications-of-derivatives> and to upload their work in google classroom to provide feedback and to assess. Assess and provide feedback, and record achievement based on the template given in the annexure.

Performance task 6

Ask students to solve the problems from Page 229 (Check Your Progress 41.4) Question 4 from the given link: <http://bit.do/Applications-of-derivatives> and to upload their work in google classroom to provide feedback and to assess. Assess and provide feedback, and record achievement based on the template given in the annexure.

D. Resources

Contact/ Non-contact

- a) BHSEC Mathematics Book II
- b) Online resource
 - <http://bit.do/Applications-of-derivatives> (pdf. file Application of calculus in Commerce and Economics) to prepare the lesson video.
 - https://youtu.be/_EXQiR9Q4kY (Explains about functions and and break even analysis with the examples)
 - <https://youtu.be/JEIH5HeneXc> (Defines about revenue function, cost function and profit function with solved problems)
 - <https://youtu.be/q3jeT5p15Zo> (Discusses about marginal and break even analysis with the examples)
- c) Technological gadgets for learning (smart phone, laptop, desktop...)

E. Annexure (S)

Refer 12B-A1 for template to record achievements.

Topic: 12B-CD1 Points and Their Coordinates in 3-Dimensions

A. Competency(ies)

- Demonstrate an understanding of use of 3-D coordinates in real life practices
- Apply distance formula, section formula and midpoint formula learnt in the classroom to real world contexts regarding direction and place
- Draw relationship between direction cosine and direction ratio

Objectives

- Apply distance formula, section formulae and midpoint formula
- Draw relationship between direction cosine and direction ratio
- Find angle between two lines using direction cosines and direction ratios.
- Determine whether two lines are perpendicular or parallel.

B. Pedagogy

Contact teaching and learning

- Direct the students to explore the 3D coordinate system for three-space and the application of 3D coordinate systems in real life in the IT lab. Also ask students to compare the 3D coordinate system with respect to the 2D coordinate system as learned in class XI
 - Share the web link https://www.youtube.com/watch?v=yPysmMXI_Is which contains a video explaining a point in 3D-coordinate system for students' reference.
- Discuss distance formula, division or section formula and midpoint formula with reference to 2D-coordinate system and their use in solving problems (refer BHSEC Mathematics Book II, page ch 13-5 to 12)
 - Display the video in the web link <https://www.youtube.com/watch?v=5sJdfciNM20> (3:15 minutes onward) which contains a video explaining the deriving of distance formula in 3D space.
 - <https://www.youtube.com/watch?v=cBbWbz0kQaQ> which contains a video explaining the section formula and solving problems using section formula.
 - https://www.youtube.com/watch?v=_ZRT4bmFYDQ which contains a video on more questions solved using section formula
- Assess students' understanding with the use of performance task 2.
- Introduce the concept of Direction cosines and direction ratios (refer the web link: <http://bit.do/direction-ratios> which contains the notes of direction cosines and direction ratios.
 - May also use the explanatory video in the web link <https://www.youtube.com/watch?v=HNTYvIVoT-U> which contains the introduction of direction cosines and direction ratios.
- Exhibit finding direction ratios of a line joining two points, angle between two lines and conditions of perpendicularity and parallelism using direction

cosines and ratios by solving related problems (refer BHSEC Mathematics Book II, page Ch 13-15 to 20).

- Assess the level of learning of students through Performance task 3.

Non-contact teaching and learning

- Share the following web link on any online learning platform to introduce a 3D coordinate system for three-space and ask the students to make notes and to compare the 3D coordinate system to that of the 2D coordinate system.
 - https://www.youtube.com/watch?v=yPysmMXI_Is which contains a video explaining a point in 3D-coordinate system.
- Post the web links given to discuss distance formula, division or section formula and midpoint formula and their use in solving problems. Ask students to make notes and compare the formulas to that in the 2D coordinate system.
 - <https://www.youtube.com/watch?v=5sJdfciNM20> (3:15 minutes onward) which contains a video explaining the distance formula in 3D space.
 - <https://www.youtube.com/watch?v=cBbWbz0kQaQ> which contains a video explaining the section formula and solving problems using section formula.
 - https://www.youtube.com/watch?v=_ZRT4bmFYDQ which contains a video on more questions solved using section formula
 - <https://byjus.com/maths/section-formula-3-dimension/> which contains notes on Section formula with solved examples and practice questions and quiz.
- Assess students' understanding with the use of Performance task 1.
- Share the following web links to introduce the concepts of direction cosines and direction ratios on any online learning platform. Ask the students to make notes.
 - <http://bit.do/direction-ratios> contains the notes of direction cosines and direction ratios.
 - <https://www.youtube.com/watch?v=HNTYvIVoT-U> contains the introduction of direction cosines and direction ratios.
- Record and post short tutorials to explain direction ratios of a line joining two points, angle between two lines and conditions of perpendicularity and parallelism using direction cosines and ratios by solving related problems (refer BHSEC Mathematics Book II, page ch 13-15 to 20). Ask students to make notes.
- Assess the level of learning of students through Performance task 2.

C. Assessment

Contact/ Non-contact

Performance task 1: (competency: Demonstrate an understanding of use of 3D coordinates in real life practices.)

Research: Allow students to explore at least 3 real life applications of points and coordinates in 3-dimensions.

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

Performance task 2: (Objective: Apply distance formula, section formulae and midpoint formula)

Homework: Devise questions aligned to the objectives (refer BHSEC Mathematics Book II, page ch 13-7 and 13-12; (sample) Exercise 13(a) - Q3, Q9 and Exercise 13(b) Q4, Q8, etc).

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

Performance task 3: (Objective: Find angle between two lines using direction cosines and direction ratios; Determine whether two lines are parallel or perpendicular)

Assignment: Prepare questions aligned to the objectives (refer BHSEC Mathematics Book II, page ch 13-20 to 22; (sample) Exercise 13(c) - Q7, Q12, Q18, Q28, etc.) and ask students to write reflection on each step used to solve the problems.

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

D. Resources

Contact/Non Contact

- a) BHSEC Mathematics Book II
- b) Technological gadgets for learning (smart phone, laptop, desk top...)
- c) Online resources:
 - https://www.youtube.com/watch?v=yPysmMXI_Is
 - <https://www.youtube.com/watch?v=5sJdfciNM20>
 - <https://byjus.com/maths/section-formula-3-dimension/>
 - <http://bit.do/direction-ratios>
 - <https://www.youtube.com/watch?v=HNTYvIVoT-U>

E. Annexure(s)

Refer 12B-A1 for template to record achievement level

Topic: 12B-CD2 Conic Section

A. Competency(ies)

- Represent equation of conic in standard form
- Find foci, directrices, eccentricity, latus rectum and axes from the given standard equation of different conics.

Objectives

- Visualize conics using appropriate digital tool
- Find the standard equation for a conic when focus, directrix, and eccentricity or related data are given
- Find basic information like foci, directrix, eccentricity, latus rectum and axes from a given standard equation of conic
- Solve practical problems related to conics

B. Pedagogy

Contact teaching and learning

- Introduce conics as sections of a plane and a right circular cone. Use <https://www.geogebra.org/m/pCg8NFVT> which is a GeoGebra worksheet on conic sections whereby one can manipulate the graph and conics by changing the angle.
 - Or may use the web link <https://www.youtube.com/watch?v=HO2zAU3Eppo> which contains a video explaining conics on a circular cone.
- Define a parabola and may use the web link <https://www.geogebra.org/m/HpQ3DdSc> which contains a GeoGebra worksheet where one can manipulate the focus and directrix and to check the points on parabola; to help students visualize a parabola as locus of points equidistant from a fixed point, focus and fixed line, directrix.
- Demonstrate finding focus, directrix, eccentricity, latus rectum and axes for any two (right handed and downward) of the four parabolas in standard forms with examples (Example 1 on page Ch 12-7 to 8 of BHSEC Mathematics Book II) Use GeoGebra or other relevant software for graphical work.
Could use the following weblinks:
 - <http://bit.do/introduction-of-parabola> contains video introducing parabolas
 - <http://bit.do/right-handed-parabola> contains video on finding focus, directrix, eccentricity, latus rectum and axes of standard form of right-handed parabola.
 - <http://bit.do/downward-parabola> contains video on finding focus, directrix, eccentricity, latus rectum and axes of standard form of downward parabola
 - <http://bit.do/standard-parabola-problems> contains the summary table of standard form of parabola, solved problems and quiz to check students' understanding.

And following web links contains video solving example questions on finding focus, directrix, eccentricity, latus rectum and axes for a given standard form of parabola

<http://bit.do/parabola-problem>

<http://bit.do/parabola-examples-2>

<http://bit.do/parabola-problems-3>

- Allow students to discuss and present finding the equation of parabola in standard form for given condition(s) (Example 2 on page ch 12-8 to 10 and exercise 12(a) Q1, 2 and 9 of BHSEC Mathematics Book II).
 - Students may also explore the use of online calculator <http://bit.do/parabola-online-calculator> to obtain the equation of parabola step by step
- Introduce Ellipse and Hyperbola simultaneously - definitions, equations of conics and components: foci, directrices, vertices, (major, minor, transverse and conjugate) axes, latus rectum and eccentricity. Use the GeoGebra worksheets <https://www.geogebra.org/m/epGhevZJ> and <https://www.geogebra.org/m/zSvbuhbT> to allow students to visualize how ellipse and hyperbola change when the components change and vice versa.
 - May use the web link to introduce ellipse and its components: <https://www.youtube.com/watch?v=cRY50CTdVvE>
 - May use the web link to introduce hyperbola and explains its components: <https://www.youtube.com/watch?v=a2niebD-3CA>
 - May also use a chart like in the web link <https://www.shelovesmath.com/precal/conics/#TableofConics> to summarise the properties of different conics.
- Discuss with students, problems related to finding the equations of ellipse and hyperbola in standard form with given condition(s) (refer BHSEC Mathematics Book II, page ch 12-18 to 23 and ch 12-30 to 33; suggested questions- Ex. 8, 13, 22, 23, 24, exercise 12(b) Q6, 20-23, 26 and exercise 12(c) Q12-15). Use GeoGebra or other relevant softwares for any graphical work.
- Assign students a task to find centre, vertices, foci, directrices, latera recta, etc. of ellipse or hyperbola when the equation of ellipse or hyperbola in standard form is given (refer BHSEC Mathematics Book II, page ch 12-18-23 and ch 12-29 to 33; suggested questions - Ex. 14, 15, 17, exercise 12(b) Q1-5, 12-15, and exercise 12(c) Q6-10). Use GeoGebra or other relevant apps for any graphical work.
Assess students' achievement of Competency(ies) using the Performance tasks.
- Allow students to explore the condition of each conic given a general equation. May explore online or refer BHSEC Mathematics Book II, page Ch 12-34 to 35 and discuss in the class.

Non-contact teaching and learning

- Share the web link on any online learning platform, to introduce conics as sections of a plane and a right circular cone
<https://www.youtube.com/watch?v=HO2zAU3Eppo> which contains a video explaining conics on a circular cone.
- Prepare and post short tutorials to explain the definition of parabola. In the tutorial use the web link <https://www.geogebra.org/m/HpQ3DdSc> which contains a GeoGebra worksheet where one can manipulate the focus and directrix and to check the points on parabola; to help students visualize a parabola as locus of points equidistant from a fixed point, focus and fixed line, directrix. Instruct students to make notes.
- Share each video in the web links provided which consists of video lessons taught on Parabola in standard form in sequence. Allow students to make notes and complete each assignment for submission and assessment.
<http://bit.do/introduction-of-parabola> contains video introducing parabolas
<http://bit.do/right-handed-parabola> contains video on finding focus, directrix, eccentricity, latus rectum and axes of standard form of right-handed parabola.
<http://bit.do/downward-parabola> contains video on finding focus, directrix, eccentricity, latus rectum and axes of standard form of downward parabola
<http://bit.do/standard-parabola-problems> contains the summary table of standard form of parabola, solved problems and quiz to check students' understanding.

And following web links contains video solving example questions on finding focus, directrix, eccentricity, latus rectum and axes for a given standard form of parabola

<http://bit.do/parabola-problem>

<http://bit.do/parabola-examples-2>

<http://bit.do/parabola-problems-3>

The web links below contain videos solving example questions on finding the equation of parabola in standard form when condition(s) are given.

<http://bit.do/finding-equation-of-parabola-part1>

<http://bit.do/finding-equation-of-parabola-part2>

<http://bit.do/finding-equation-of-parabola-part3>

Students may also explore the use of online calculator

<http://bit.do/parabola-online-calculator> to obtain the equation of parabola step by step

- Post the following links to introduce Ellipse and Hyperbola simultaneously - definitions, equations of conics and components: foci, directrices, vertices, (major, minor, transverse and conjugate) axes, latus rectum and eccentricity. Ask students to make notes.
 - May use the web link to introduce ellipse and its components:
<https://www.youtube.com/watch?v=cRY50CTdVvE>

- May use the web link to introduce hyperbola and explains its components:
<https://www.youtube.com/watch?v=a2niebD-3CA>
- May also use a chart like in the web link
<https://www.shelovesmath.com/precacal/conics/#TableofConics> to summarise the properties of different conics.
- Share each of the following web links which consist of video lessons introducing and solving problems on Ellipse in standard form. Allow students to make notes and complete each assignment for submission and assessment.
<http://bit.do/explanation-of-components-ellipse>
<http://bit.do/ellipse-problem-solving-1>
<http://bit.do/ellipse-problem-solving-2>
<http://bit.do/ellipse-problem-solving-3>
<http://bit.do/ellipse-problem-solving-4>
<http://bit.do/ellipse-problem-solving-5>
<http://bit.do/ellipse-problem-solving-6>
<http://bit.do/ellipse-problem-solving-7>
<http://bit.do/ellipse-problem-solving-8>
Students may also explore the use of online calculator
<https://www.emathhelp.net/calculators/algebra-2/ellipse-calculator/> to obtain the equation of ellipse step by step
- Share each of the following web links which consists of video lessons introducing and solving questions on Hyperbola in standard form. Allow students to make notes and complete the assignment provided in the video for submission and assessment.
<http://bit.do/introduction-to-hyperbola-and-its-compnents>
<http://bit.do/hyperbola-problem-solving-1>
<http://bit.do/hyperbola-problem-solving-2>
Students may also explore the use of online calculator
<https://www.emathhelp.net/calculators/algebra-2/hyperbola-calculator/> to obtain the equation of hyperbola step by step
- Assess students achievement of Competency(ies)/objectives using the performance tasks.

C. Assessment

Contact/ Non-contact

Performance task 1: (competency: Demonstrate an understanding of the conic section as an interactive tool for visual presentation)

Take students to the school IT laboratory and guide them each to work through the following GeoGebra sheets to manipulate the focus, directrix, and vertex and notice how the conics are changing.

Provide relevant problems from each conic (refer BHSEC Mathematics Book II, chapter 12, exercise 12(a, b and c)) to solve manually and by the use of

GeoGebra sheets. Instruct students to write a reflection on use of these two methods.

<https://www.geogebra.org/m/Dhh8qyNt> contains a GeoGebra worksheet on parabola

<https://www.geogebra.org/m/vZ6T6S23> contains a GeoGebra worksheet on ellipse

<https://www.geogebra.org/m/FVfq4Sz3> contains a GeoGebra worksheet on hyperbola.

For non-contact: Prepare and post short tutorials on use of the above GeoGebra sheets to fulfill the performance task with an example and allow students to complete the task individually.

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

Performance task 2: (competency: Solve the practical problems on conic section)

Short test: At the end of the chapter, design a test aligned to the objective (refer BHSEC Mathematics Book II, chapter 12, exercise 12(a, b, and c) and assess their understanding.

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

D. Resources

Contact

- a) BHSEC Mathematics Book II
- b) Teacher's guide book for class XII
- c) Online resources:
 - <https://www.geogebra.org/m/pCg8NFVT>
 - <https://www.youtube.com/watch?v=HO2zAU3Eppo>
 - <https://www.geogebra.org/m/HpQ3DdSc>
 - <http://bit.do/introduction-of-parabola>
 - <http://bit.do/right-handed-parabola>
 - <http://bit.do/downward-parabola>
 - <http://bit.do/standard-parabola-problems>
 - <http://bit.do/parabola-problem>
 - <http://bit.do/parabola-examples-2>
 - <http://bit.do/parabola-problems-3>
 - <http://bit.do/parabola-online-calculator>
 - <http://bit.do/general-form-parabola-problem>
 - <https://www.geogebra.org/m/epGhevZJ>

- <https://www.youtube.com/watch?v=cRY50CTdVvE>
- <https://www.youtube.com/watch?v=a2niebD-3CA>
- <https://www.shelovesmath.com/precal/conics/#TableofConics>
- <https://www.geogebra.org/m/Dhh8qyNt>
- <https://www.geogebra.org/m/vZ6T6S23>
- <https://www.geogebra.org/m/FVfq4Sz3>

Non-contact

- a) Technological gadgets for learning (smart phone, laptop, desk top...)
- b) BHSEC Mathematics Book II
- c) Teacher's guide book for class XII
- d) Online resource:
 - <https://www.youtube.com/watch?v=HO2zAU3Eppo>
 - <https://www.geogebra.org/m/HpQ3DdSc>
 - <http://bit.do/introduction-of-parabola>
 - <http://bit.do/right-handed-parabola>
 - <http://bit.do/downward-parabola>
 - <http://bit.do/standard-parabola-problems>
 - <http://bit.do/parabola-problem>
 - <http://bit.do/parabola-examples-2>
 - <http://bit.do/parabola-problems-3>
 - <http://bit.do/finding-equation-of-parabola-part1>
 - <http://bit.do/finding-equation-of-parabola-part2>
 - <http://bit.do/finding-equation-of-parabola-part3>
 - <http://bit.do/parabola-online-calculator>
 - <https://www.youtube.com/watch?v=cRY50CTdVvE>
 - <https://www.youtube.com/watch?v=a2niebD-3CA>
 - <https://www.shelovesmath.com/precal/conics/#TableofConics>
 - <http://bit.do/explanation-of-components-ellipse>
 - <http://bit.do/ellipse-problem-solving-1>
 - <http://bit.do/ellipse-problem-solving-2>
 - <http://bit.do/ellipse-problem-solving-3>
 - <http://bit.do/ellipse-problem-solving-4>
 - <http://bit.do/ellipse-problem-solving-5>
 - <http://bit.do/ellipse-problem-solving-6>
 - <http://bit.do/ellipse-problem-solving-7>
 - <http://bit.do/ellipse-problem-solving-8>
 - <http://bit.do/parabola-online-calculator>
 - <http://bit.do/Ellipse-BHSEC-class-12>
 - <https://www.emathhelp.net/calculators/algebra-2/ellipse-calculator/>
 - <http://bit.do/introduction-to-hyperbola-and-its-components>
 - <http://bit.do/hyperbola-problem-solving-1>

- <http://bit.do/hyperbola-problem-solving-2>
- <https://www.emathhelp.net/calculators/algebra-2/hyperbola-calculator/>
- <https://www.geogebra.org/m/Dhh8qyNt>
- <https://www.geogebra.org/m/vZ6T6S23>
- <https://www.geogebra.org/m/FVfq4Sz3>

E. Annexure(s)

Refer 12B-A1 for template to record achievement levels

Topic: 12B-E1 Correlation

A. Competency(ies)

- Calculate coefficient of correlation using relevant software for ungrouped data and interpret the result

Objectives

- Determine the association between the data set using correlation.
- Calculate coefficient of correlation for ungrouped data and interpret the result
- Calculate rank correlation coefficient (for both repeating and non-repeating ranks) and interpret the result.

B. Pedagogy

Contact teaching and learning

- This chapter and the next, the student will be assessed on the basis of their project work where the students will be required to collect their own data at the start of the chapter and study their data till the end of the two chapters - correlation and regression..
- Carry out Performance task 1 before the start of the chapter.
- Project the video in the web link <https://www.youtube.com/watch?v=8nxXOEfZeHs> to explain the correlation between two variables with the use of scatter plot and provide notes.
- Carry out Performance task 2.
- Discuss Karl Pearson's formulas of calculating and interpreting the correlation coefficient between two variables with relevant examples (refer BHSEC Mathematics Book II, page Ch 16-6 to 14) and allow students to demonstrate their understanding with homework tasks.
May also use the web links:
<https://www.youtube.com/watch?v=2CEGh1emkzM> contains a video on use of covariance formula to find Karl Pearson's coefficient of correlation.
- Carry out Performance task 3.
- Project the video in the following web link to explain the Spearman's rank correlation coefficient with an example:
<http://bit.do/spearmans-rank-correlation-coefficient> contains a video solving an example using the formula of Spearman's rank correlation coefficient.
- Allow students in groups to examine a few questions on Spearman's rank correlation coefficient for tied rank (refer BHSEC Mathematics Book II, page Ch 16-20 to 24) and present their results and interpretations to the class.
- Carry out Performance task 4.

Non-contact teaching and learning

- This chapter and the next, the student will be assessed on the basis of their project work where the students will be required to collect their own data at

the start of the chapter and study their data till the end of the two chapters - correlation and regression..

- Carry out Performance task 1 before the start of the chapter.
- Share the video in the web link <https://www.youtube.com/watch?v=8nxXOefZeHs> to explain the correlation between two variables with the use of scatter plot and provide notes.
- Carry out Performance task 2.
- Conduct an online Zoom class explaining Karl Pearson's formulas of calculating and interpreting the correlation coefficient between two variables with relevant examples. May prepare a PowerPoint Presentation for the online class. (refer BHSEC Mathematics Book II, page Ch 16-6 to 14).
 - Share the ppt file on the online learning platform for students to make notes and assign students similar questions as homework.
 - May also share the method in the web links: <https://www.youtube.com/watch?v=2CEGh1emkzM> contains a video on use of covariance formula to find Karl Pearson's coefficient of correlation.
- Carry out Performance task 3.
- Share the video in the following web link to explain the Spearman's rank correlation coefficient with an example: <http://bit.do/spearmans-rank-correlation-coefficient> contains a video solving an example using the formula of Spearman's rank correlation coefficient.
- Direct students to examine a few questions on Spearman's rank correlation coefficient for tied rank (refer BHSEC Mathematics Book II, page Ch 16-20 to 24) and submit their results and interpretations in the form of video explanations.
- Carry out Performance task 4.

C. Assessment

Contact/ Non-contact

Performance task 1:

In the first class of the chapter, describe the project work and its rubrics to the students and assign them their first task:

- Instruct students to collect data with two variables with around 50 observations. Provide a few examples: 1. Marks in two subjects of 50 students in the same stream, 2. height vs weight of 50 students in the school, etc. (refer examples or exercise questions of BHSEC Mathematics Book II).
- Check their work and discourage any form of plagiarism.
- For non-contact: students may explore the web for collection of relevant data sets.

Performance task 2:

Project work: In the school IT lab, demonstrate an example on an Excel sheet to punch in data and generate a scatter plot.

Allow students to do the same for their data set. Instruct students to either print or copy the scatter plot and attach into their project work with an analysis of the plot to describe the direction and degree of the correlation between the data.

Performance task 3:

Project work: Using Excel sheet, demonstrate how to find the values of

\bar{x} , \bar{y} , σ_x , σ_y , $\text{Cov}(x, y)$, $\sum x^2$, $\sum y^2$, $\sum xy$, etc. (all the values needed to use each of Karl

Pearson's correlation coefficient formula)

Instruct the students to use Excel sheets to work the above values of their data and to use an appropriate formula of Karl Pearson's to find the correlation coefficient and interpret the result. (Encourage students to use formulas and manually find the values such as \bar{x} , \bar{y} , σ_x , σ_y , $\text{Cov}(x, y)$ and using the information compiled from the spreadsheet)

Instruct the students to attach a printed copy of the excel sheet and the solution and interpretation of the solution, into their project work.

Performance task 4:

Project work: Using Excel sheet, demonstrate how to assign ranks (tied or not)

for their data and find the values of \bar{x} , \bar{y} , σ_x , σ_y , $\text{Cov}(x, y)$ and $\sum R^2$ (all the values needed to use the formula for Rank correlation coefficient).

Instruct the students to use Excel sheets to work the above values of their data and to use Spearman's rank correlation coefficient to find and interpret the correlation between the variables of their data. (Encourage students to use formulas and manually find the values of using the information compiled from the spreadsheet)

Also ask the students to write reflection on the correlation coefficients found using the two methods (Karl Pearson's coefficient and Spearman's rank coefficient) and to attach all their completed activities into the project work. Students may read the article on the web link below, to compare further between Pearson's and Spearman's correlation coefficient (if interested) :

http://qeoinfo.amu.edu.pl/qg/archives/2011/QG302_087-093.pdf

Note:

- In non-contact assessment, record and post short tutorials demonstrating the use of excel sheets for each performance task.
- Teachers may set rubrics to assess the competencies.

Sample:

Expectations	Met (✓) Not met(X)	Comments
1. Collected relevant data with two variables		
2. Correct scatter plot generated		
3. Interpreted the direction and degree of correlation correctly from the scatter plot		
4. All the values accurately calculated on the excel sheet with right use of formulas (PT 3).		
5. Appropriate formula used to calculate the Pearson's coefficient of correlation		
6. Analysis and interpretation of the correlation coefficient done correctly		
7. All the values accurately calculated on the excel sheet with right use of formulas (PT 4).		
8. Accurate rank correlation coefficient found and analysis and interpretation of the correlation coefficient done correctly		

- If 7-8 expectations are met - Exceeding
- If 5-6 expectations are met - Meeting
- If 3-4 expectations are met - Approaching
- If 1-2 expectations are met - Beginning

D. Resources

Contact/Non Contact

- a) BHSEC Mathematics Book II
- b) Technological gadgets for learning (smart phone, laptop, desk top...)
- c) Online resources:
 - <https://www.youtube.com/watch?v=8nxXOEFZeHs>
 - <https://www.youtube.com/watch?v=2CEGh1emkzM>
 - <http://bit.do/spearmans-rank-correlation-coefficient>
 - http://geoinfo.amu.edu.pl/qg/archives/2011/QG302_087-093.pdf

E. Annexure(s)

Refer 12B-A1 for template to record achievement levels

Topic: 12B-E2 Regression

A. Competency(ies)

- Measure the degree of dependence of one variable on the other through regression coefficient
- Apply the concept of lines of regression to solve problems associated with regression

Objectives

- Define and differentiate between correlation and regression
- Calculate regression coefficient
- Solve problems with two lines of regression
- Use lines of regression to make predictions

B. Pedagogy

Contact teaching and learning

- In this chapter, the students will continue to work and compile on their project work.
- Provide a set of paired-data and allow students to plot scatter diagrams roughly and draw the line of best fit. Deduce the definition of regression and lines of regression from the example.
 - May also use the web link:
<https://www.youtube.com/watch?v=zPG4NjlkCjc&t=68s> contains a video explaining a regression of y on x.
- Explain the summary table of list of formulae for regression analysis (may also relate to Karl Pearson's formulas) (refer BHSEC Mathematics Book II, page Ch 17-11 to 12)
- Discuss and solve questions of the type: 'when equations of regression lines are given' (refer BHSEC Mathematics Book II, page Ch 17-26 to 28, suggested questions: 5(i) and Q8). Assign similar questions as homework.
- Demonstrate an example on the type: finding equations of regression lines and allow students in groups to examine similar questions (refer BHSEC Mathematics Book II, page Ch 17-12 to 28) and present their results and interpretations to the class.
- Carry out Performance task 1 and 2.

Non-contact teaching and learning

- In this chapter, the students will continue to work and compile on their project work.
- Post a recorded video on recapitulation on scatter plot and line of best fit and reduce the definition of regression and lines of regression with example. Allow students to make notes.

- May also share the web link:
<https://www.youtube.com/watch?v=zPG4NjlkCjc&t=68s> contains a video explaining a regression of y on x.
- Conduct a Zoom online class presenting and explaining the summary table of list of formulae for regression analysis (may also relate to Karl Pearson's formulas) (refer BHSEC Mathematics Book II, page Ch 17-11 to 12).
- Send the students solved questions of the type: 'when equations of regression lines are given' with visual explanation (refer BHSEC Mathematics Book II, page Ch 17-26 to 28, suggested questions: 5(i) and Q8). Assign similar questions as homework.
- Demonstrate an example on the type: finding equations of regression lines, in a tutorial and allow students to examine similar questions (refer BHSEC Mathematics Book II, page Ch 17-12 to 28) and submit their results and interpretation for submission.
- Carry out Performance task 1 and 2.

C. Assessment

Contact/ Non-contact

Performance task 1:

Project work: Demonstrate generating line of best fit using Excel sheets. Instruct students to generate scatter plots and the line of best fit i) when first variable (x) is taken as independent and the second variable (y) is taken as dependent variable, ii) when y is taken as independent and x is taken as dependent variable..

Find the slope and the y-intercepts of each of the regression lines y on x and x on y and find the equation of the lines: $y = mx + c$ and $x = my + d$. Ask the students to attach their findings to their project work.

Performance task 2:

Project work: Instruct students to use Excel sheets to manipulate their data collected and find the equations of regression lines of y on x and x on y by using the relation: $(y - \bar{y}) = r(x - \bar{x})$ and $(x - \bar{x}) = r(y - \bar{y})$ (Students should be able to complete this task without much assistance since they have already been working on Excel sheet for similar tasks)

- Instruct students to compare the results with that of in performance task 1.
- Students will make predictions using their regression lines for an assumed value of x and an assumed value of y.
- Students should also describe the interdependence of the two variables of their data by analyzing the results obtained in correlation and regression.

Allow students to compile all the work from each task into the project work and submit for assessment of each competency.

Note:

- In non-contact assessment, record and post short tutorials demonstrating the use of excel sheets for each performance task.
- Teachers may set rubrics to assess the competencies.

Sample:

Expectations	Met (✓) Not met(X)	Comments
1. Regression lines of y on x and x on y accurately generated.		
2. Values of slope and y-intercept correctly worked out		
3. Found correct equations of regression lines of y on x and x on y		
4. All the values accurately calculated on the excel sheet with right use of formulas (PT 2).		
5. Appropriate formula used to calculate the regression coefficients (<i>and</i>) and found equations of the regression line correctly.		
6. Analysis and interpretation of the correlation coefficient done correctly		
7. Used a relevant regression line to predict the value of y for assumed value of x and vice versa.		
8. Correct deduction of dependency of the two variables made.		

- If 7-8 expectations are met - Exceeding
- If 5-6 expectations are met - Meeting
- If 3-4 expectations are met - Approaching
- If 1-2 expectations are met - Beginning

D. Resources

Contact/Non Contact

- a) BHSEC Mathematics Book II
- b) Technological gadgets for learning (smart phone, laptop, desk top...)
- c) Online resources:
 - <https://www.youtube.com/watch?v=zPG4NjlkCjc&t=68s>

E. Annexure(s)

Refer 12B-A1 for template to record achievement levels

Topic: 12B-E3 Probability

A. Competency(ies)

- Use the concept of permutation and combination in calculating probability
- Determine probabilities of various events by applying the laws and concepts of probability

Objectives

- Use the concept of permutation and combination in calculating probability
- Apply different laws of probability in solving problems related to probability

B. Pedagogy

Contact teaching and learning

- Pre – Assessment:
 - Recapitulate the following topics: a) set theory of probability, b) calculating probability using addition and multiplication laws related to two coins or dice, three unbiased coins or dice involving “at least”, at the most, and “not all”. c) Permutation and combination
 - For revision of permutation and combination use the link: <https://www.youtube.com/watch?v=tnF9f3zCCKI> (suggested timing - till up to 10 minutes). Before watching the video, a teacher should bring the printed six questions which are there in the video lesson and conduct a brainstorming session, asking them to solve individually. After completing, the teacher and student will watch the video lesson and discuss and do corrections simultaneously.
- Calculating probability using Permutation and combination:
 - The link https://www.youtube.com/watch?v=RNH_O2QvkWA which contains a video lesson on the concepts of calculating probability using permutation and combination will be discussed in the class. The teacher will do blended teaching and pause the video wherever required. Design a similar question like a video lesson, the question will be distributed to children and assign an individual task.
- Calculating probability using permutation:
 - Select one question each from the following links and discuss in the class: <http://bit.do/suit-case>, <http://bit.do/letter-dictated>, and <http://bit.do/ticket-sold>.
- Calculating probability using combination:
 - Select one question each from the following links and discuss in the class: <http://bit.do/lottery-sold>, <http://bit.do/queen-and-king>, and <http://bit.do/class-friend>
 - Assign a group task: At least select nine or ten examples from BHSEC Mathematics Book II, page number Ch 18-29 to 34, and after completing ask them to present their finding and understanding.

- Combining Probabilities:
 - Explain flowchart of combining probabilities (refer to BHSEC Mathematics Book II, page number Ch 18-38). Ask them to explore and investigate the link given <https://www.youtube.com/watch?v=DOooyE6liLY> which contains a lesson on building the concepts on the addition rule of probabilities. Students will be given an opportunity to demonstrate their knowledge by exploring selected questions from Exercise 18(e) from BHSEC Mathematics Book II, page number Ch 18-38 to 39.
- Theorems on Probabilities:
 - Theorems on probabilities will be taught through PowerPoint presentation (revision). To investigate the theorem, at least select seven or eight examples from the text and instruct them to do a presentation.
- Successive Trial - Independent and dependent events:
 - Discuss the question from the video link <http://bit.do/dependent-independent> which contains the concepts with examples for finding probability like dependent and independent events (revision). May refer to BHSEC Mathematics Book II, page number Ch 18-49 to 50.
- Multiplication Theorem on Probability:
 - Provide the link <https://www.youtube.com/watch?v=BQRQBnsKUOU> which contains the concepts on multiplication theorem on probability.
 - Provide notes on **Useful Remarks** subtopic related to multiplication of probability referring to BHSEC Mathematics Book II, page number Ch18-51 to 52.
- Examples Discussion (*resource can be avail from BHSEC Mathematics Book II, page number Ch18-52 to 68*):
 - Proving independent or dependent of events (Type I): Build a concept demonstrating the following examples (e.g.49, e.g. 50, and e.g.51)
 - Finding probabilities of simultaneous occurrence of two independent events (Type II): Select the following examples (e.g. 53, e.g.54, e.g.55, and e.g.56) and ask them to explore and do the presentation.
 - Finding the probability of occurrence of at least one event for independent events (Type III): Demonstrate three examples from Type III, discuss the logical reason, approach, methods, and solution.
 - Problems solved by using both the addition and multiplication theorem of probability (Type IV): Around ten or eleven examples will be selected and ask students to come up with short video recording, encourage them to explore and investigate themselves.
- Conditional probability:
 - Use the link <https://www.youtube.com/watch?v=JGeTcRfKgBo> which contains a video lesson on conditional probability.

- Investigate and explore the link <http://bit.do/conditional-probability> (link contains notes and video lesson on conditional probability). Conduct an active interactive session and discuss the following topics from the same link:
 - a) What is conditional probability? b) Formula for conditional probability? c) How to find the conditional probability from a word problem and its solution? Explore the same link and discuss the video lesson on: a) How to use real-world examples to explain conditional probability? b) How to define conditional probability? c) How to calculate conditional probability? And d) How to determine the conditional probability from the given word problems? Suggestion: Could use the resource from BHSEC Mathematics Book II, page number Ch 18-74 to 76. To support the concepts, demonstrate and teach the five or six examples from BHSEC Mathematics Book II, page number Ch 18-77 to 79.
- Multiplication Theorem of probability for dependent events:
 - Prove three multiplication theorems for dependent events from BHSEC Mathematics Book II, page number Ch 18-79. Could use <http://bit.do/multiplication-theorem> for supplement.
 - Assign an individual task: Let students choose any four examples from the same book (refer page number on Ch 18-79 to 81) and instruct them to design three similar questions.

Non-Contact teaching and learning

- Pre – Assessment:
 - Upload the below instruction in the Google Classroom:
 - Recapitulate the following topics: a) set theory of probability, b) calculating probability using addition and multiplication laws related to two coins or dice, three unbiased coins or dice involving “at least”, at the most, and “not all”. c) Permutation and combination
 - For revision of permutation and combination use the link: <https://www.youtube.com/watch?v=tnF9f3zCCKI> (suggested timing - till up to 10 minutes). Before watching the video, upload the printed six questions which are in the video lesson and conduct a brainstorming session, asking them to solve individually. After completing, a student will be asked to watch the video lesson and let them do self-checking.
- Calculating probability using Permutation and combination:
 - Conduct Virtual Class:
 - The link https://www.youtube.com/watch?v=RNH_O2QvkWA which contains a lesson on the concepts calculating probability using permutation and combination needed to discuss during an online class. The teacher will do a blended online teaching and pause the video

wherever required. Design a similar question like a video lesson, the question will be distributed to children and assign an individual task.

- Calculating probability using permutation:
 - A total of three questions will be selected each from the link given and it will be uploaded in the relevant social media class forum (or Google Classroom) for discussion. Instruct children to come up with methods and strategies, and their findings will be discussed online.
The following links are:
<http://bit.do/suit-case>
<http://bit.do/letter-dictated>
<http://bit.do/ticket-sold>
The solutions from the link will be discussed and ask them to make necessary changes.
- Calculating probability using combination:
 - Task I: Select one question each from the following links and discuss the examples: <http://bit.do/lottery-sold>, <http://bit.do/queen-and-king>, and <http://bit.do/class-friend>.
 - Task II: Assign a group task, select nine or ten examples from BHSEC Mathematics Book II, page number Ch 18-29 to 34, and instruct them to solve in group. After completing, ask them to present their findings
 - Task III: Assign an individual task, ask them to come up with a similar question related to the topic.
- Combining Probabilities:
 - Upload flow chart of combining probabilities in the relevant social media forum (*teacher can refer to source from BHSEC Mathematics Book II, page number Ch 18-38*). Ask them to explore and investigate the link given <http://bit.do/combining-probability> which contains a lesson for building the concepts on the addition rule of probabilities. Students will be given an opportunity to demonstrate their knowledge by exploring selected questions from Exercise 18(e) from BHSEC Mathematics Book II, page number Ch 18-38 to 39. The class can be conducted online.
- Theorems on Probabilities:
 - Conduct online Class: Theorems on probabilities will be taught through power point presentation (*revision*). To investigate the theorem, select seven or eight examples from the text (*BHSEC Mathematics Book II, page number Ch 18-39 to 42*) and check how much they have understood, allowing students to do presentations.
- Successive Trial - Independent and dependent events:
 - The link will be uploaded in Google Classroom and ask them to explore the question and remind them to write the notes from the video link <http://bit.do/dependent-independent> (*link which contains the concepts with examples on finding the probability dependent and independent events*)

(revision)). As an assignment, students will be given to explore more examples from the relevant links.

- Multiplication Theorem on Probability:
 - Online Class:
 - Explore the link <https://www.youtube.com/watch?v=BQrQBnsKUOU> (revision) which contains concepts on multiplication theorem on probability.
 - Provide a note on useful **Remarks Subtopic** related to multiplication of probability referring to BHSEC Mathematics Book II, page number Ch 18-51 to 52. Ask the students to go through notes and remind them to do self study.
- Examples Discussion (resource can be avail from BHSEC Mathematics Book II, page number Ch18-52 to 68):
 - Conduct online class:
 - Proving independent or dependent of events (Type I): Build a concept demonstrating the following examples (e.g.49, e.g. 50, and e.g.51)
 - Finding probabilities of simultaneous occurrence of two independent events (Type II): Select the following examples (e.g. 53, e.g.54, e.g.55, and e.g.56) and ask them to explore themselves and do presentation during virtual learning.
 - Finding the probability of occurrence of at least one event for independent events (Type III): Demonstrate three examples from Type III, discuss the logical reason, approach, methods, and solution accordingly.
 - Problems solved by using both the addition and multiplication theorem of probability (Type IV): Around ten or eleven examples will be selected and ask students to come up with short video recording, encourage them to explore and investigate methods and approach themselves.
- Conditional probability:
 - Conditional probability can be taught through online class:
 - The link <https://www.youtube.com/watch?v=JGeTcRfKgBo> which contains a video lesson on the conditional probability that will be shared.
 - Investigate and explore the link <http://bit.do/conditional-probability> (link contains notes and video lesson on conditional probability). Conduct an active interactive session and discuss the following topics from the same link:
 - a) What is conditional probability? b) Formula for conditional probability? c) How to find the conditional probability from a word problem and its solution? Explore the same link and discuss the video lesson on:
 - a) How to use real-world examples to explain conditional probability? b) How to define conditional probability? c) How to calculate conditional probability? And d) How to determine the conditional probability from the given word problems? Suggestion:

Could use the resource from BHSEC Mathematics Book II, page number Ch 18-74 to 76. To support the concepts, demonstrate and teach the five or six examples from BHSEC Mathematics Book II, page number Ch 18-77 to 79.

- Multiplication Theorem of probability for dependent events:
 - Individual Learning:
 - Short video lesson on the topic proving three multiplication theorems for dependent events will be posted in the Google Classroom. (Refer BHSEC Mathematics Book II, page number Ch 18-79). Ask students to explore the video lesson and remind them of the need of writing notes accordingly. For supplement share the link <http://bit.do/multiplication-theorem> and ask them to explore themselves.
 - Assign an individual task: select any four examples from the same book (refer page number on Ch 18-79 to 81) will be uploaded in Google class and instruct them to design three similar questions.

C. Assessment

Contact/ Non-Contact

Performance Task 1: (Objectives: Use the concept of permutation and combination in calculating probability)

Group Task:

Conduct Quiz: Conduct quiz selecting questions from the link <http://bit.do/permutation-and-combination-probability>. The solution for the quiz questions will be discussed thoroughly using the video link before proceeding to next quiz questions (Optional: you can trim the video into question wise or pause the video accordingly to question).

Individual Task:

Let students explore and find probability using permutation and combination on the question assigned by the teacher. The questions can be given from the BHSEC Mathematics Book II, page number Ch 18-34 to 37, Exercise 18(d).

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

Performance Task 2:

Objectives: (Apply different laws of probability in solving problems related to probability)

Assign questions relevant to the objectives from Exercise: 18 (f), 18(g), 18(h), and 18(j) given in page no. Ch18-34 to 82, BHSEC Mathematics Book II.

Assess, provide feedback and record achievement based on the templates given in the annexure 12B-A1

D. Resources

Contact

- a) BHSEC Mathematics Book II
- b) Online resources:
 - <https://www.youtube.com/watch?v=tnF9f3zCCKI>
 - https://www.youtube.com/watch?v=RNH_O2QvkWA
 - <http://bit.do/suit-case>
 - <http://bit.do/letter-dictated>
 - <http://bit.do/ticket-sold>
 - <http://bit.do/lottery-sold>
 - <http://bit.do/queen-and-king>
 - <http://bit.do/class-friend>
 - <https://www.youtube.com/watch?v=DOooyE6liLY>
 - <http://bit.do/dependent-independen>
 - <https://www.youtube.com/watch?v=BQrQBnsKUOU>
 - <https://www.youtube.com/watch?v=JGeTcRfKgBo>
 - <http://bit.do/conditional-probability>
 - <http://bit.do/multiplication-theorem>
 - <http://bit.do/permutation-and-combination-probability>

Non-Contact

- a) Technological gadgets for learning (smart phone, laptop, desk top...)
- b) BHSEC Mathematics Book II
- c) Online resources:
 - <https://www.youtube.com/watch?v=tnF9f3zCCKI>
 - https://www.youtube.com/watch?v=RNH_O2QvkWA
 - <http://bit.do/suit-case>
 - <http://bit.do/letter-dictated>
 - <http://bit.do/ticket-sold>
 - <http://bit.do/lottery-sold>
 - <http://bit.do/queen-and-king>
 - <http://bit.do/class-friend>
 - <https://www.youtube.com/watch?v=DOooyE6liLY>
 - <http://bit.do/dependent-independen>
 - <https://www.youtube.com/watch?v=BQrQBnsKUOU>
 - <https://www.youtube.com/watch?v=JGeTcRfKgBo>
 - <http://bit.do/conditional-probability>
 - <http://bit.do/multiplication-theorem>
 - <http://bit.do/permutation-and-combination-probability>

E. Annexure(s)

Refer 12B-A1 for template to record achievement levels